# GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1995

By

D.V. Allen, J.I. Steiger, and others

U.S. Geological Survey

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# CONTENTS



**ILLUSTRATIONS**

**ILLUSTRATIONS—Continued**

## ILLUSTRATIONS—Continued



## TABLES

# CONVERSION FACTORS

| Multiply | By | To obtain |
|---|---|---|
| acre-foot | 1233 | cubic meter |
| foot | 0.3048 | meter |
| inch | 25.4 | millimeter |
| mile | 1.609 | kilometer |

Chemical concentration is reported only in metric units—milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

# DEFINITION OF TERMS

**Acre-foot (AC-FT, acre-ft)**—The quantity of water required to cover one acre to a depth of one foot; equal to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

**Aquifer**—A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

**Artesian**—Describes a well in which the water level stands above the top of the aquifer tapped by the well (confined). A flowing artesian well is one in which the water level is above the land surface.

**Dissolved**—Material in a representative water sample that passes through a 0.45–micrometer membrane filter. This is a convenient operational definition used by Federal agencies that collect water data. Determinations of "dissolved" constituents are made on subsamples of the filtrate.

**Land-surface datum (lsd)**—A datum plane that is approximately at land surface at each ground-water observation well.

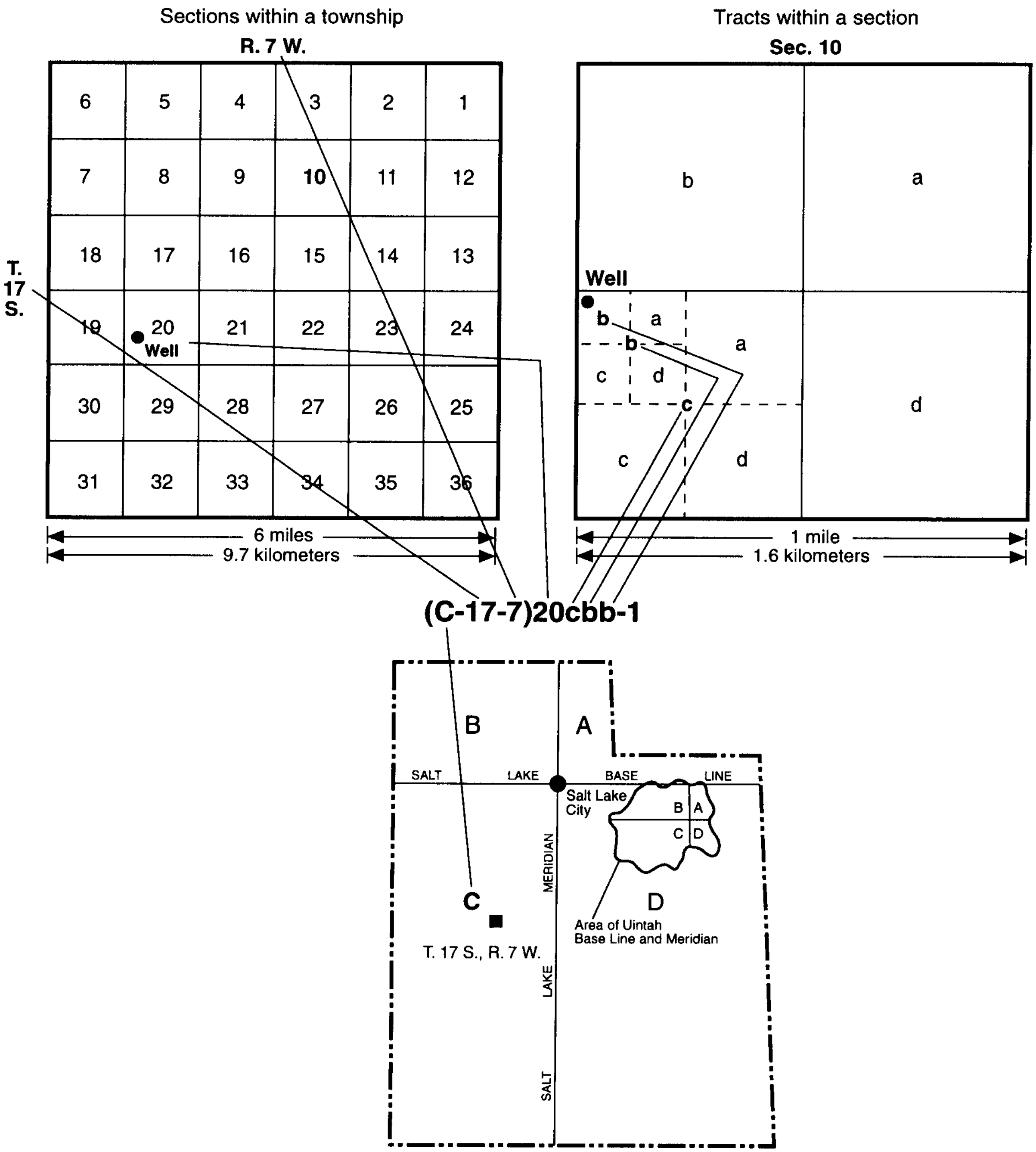
**Milligrams per liter (MG/L, mg/L)**—A unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represents the mass of solute per unit volume (liter) of water.

**Specific conductance**—A measure of the ability of water to conduct an electrical current. It is expressed in microsiemens per centimeter at 25 degrees Celsius. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in microsiemens). This relation is not constant in water from one well or stream to another, and it may vary for the same source with changes in the composition of the water.

**Cumulative departure from average annual precipitation**—A graph of the departure or difference between the average annual precipitation and the value of precipitation for each year, plotted cumulatively. A cumulative plot is generated by adding the departure from average precipitation for the current year to the sum of departure values for all previous years in the period of record. A positive departure, or greater-than-average precipitation, for a year results in a graph segment trending upward; a negative departure results in a graph segment trending downward. A generally downward-trending graph for a period of years represents a period of generally less-than-average precipitation, which commonly causes and correlates with declining water levels in wells. Likewise, a generally upward-trending graph for a period of years represents a period of greater-than-average precipitation, which commonly causes and correlates with rising water levels in wells. However, increases or decreases in withdrawals of ground water from wells also affect water levels and can change or eliminate the correlation between water levels in wells and the graph of cumulative departure from average precipitation.

# WELL-NUMBERING SYSTEM

The well-numbering system used in Utah is based on the Bureau of Land Management's system of land subdivision. The well-numbering system is familiar to most water users in Utah, and the well number shows the location of the well by quadrant, township, range, section, and position within the section. Well numbers for most of the State are derived from the Salt Lake Base Line and the Salt Lake Meridian. Well numbers for wells located inside the area of the Uintah Base Line and Meridian are designated in the same manner as those based on the Salt Lake Base Line and Meridian, with the addition of the "U" preceding the parentheses. The numbering system is illustrated below.



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## INTRODUCTION

This is the thirty-second in a series of annual reports that describe ground-water conditions in Utah. Reports in this series, published cooperatively by the U.S. Geological Survey and the Utah Department of Natural Resources, Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, related changes in precipitation and streamflow, and chemical quality of water. Supplementary data, such as maps showing water-level contours, are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected significant areas of ground-water development in the State for the calendar year 1994. Water-level fluctuations and selected related data, however, are described from the spring of 1990 to the spring of 1995. Much of the data used in the report were collected by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Divisions of Water Rights and Water Resources.

The following reports that deal with ground water in the State were printed by the U.S. Geological Survey or by cooperating agencies from February 1994 through April 1995:

Ground-water conditions in Utah, spring of 1994, by D.V. Allen, R.B. Garrett, and others, Utah Division of Water Resources Cooperative Investigations Report No. 34.

Physical characteristics and quality of water from selected springs and wells in the Lincoln Point-Bird Island area, Utah Lake, Utah, by R.L. Baskin, L.E. Spangler, and W.F. Holmes, U.S. Geological Survey Water-Resources Investigations Report 93-4219.

Ground-water hydrology of Ogden Valley and surrounding area, eastern Weber County, Utah, and simulation of ground-water flow in the valley-fill aquifer system, by Charles Avery, Utah Department of Natural Resources Technical Publication No. 99.

Hydrogeology of recharge areas and water quality of the principal aquifers along the Wasatch Front and adjacent areas, Utah, by P.B. Anderson, D.D. Susong, S.R. Wold, V.M. Heilweil, and R.L. Baskin, U.S. Geological Survey Water-Resources Investigations Report 93-4221.

Selected hydrologic data for Juab Valley, 1935-94, by J.I. Steiger, U.S. Geological Survey Open-File Report 95-101.

Hydrology of the L.C. Holding coal-lease trace and adjacent areas, southwestern Utah, and potential effects of coal mining, by G.E. Cordy, R.I. Seiler, and B.J. Stolp, U.S. Geological Survey Water-Resources Investigations Report 91-4111.

Maps summarizing geohydrologic information in an area of salt-water disposal, eastern Altamont-Bluebell Petroleum Field, Uinta Basin, Utah, by G.W. Freethey, U.S. Geological Survey Water-Resources Investigations Report 92-4043.

Determination of hydrologic properties needed to calculate average linear velocity and travel time of ground water in the principal aquifer underlying the southeastern part of Salt Lake Valley, Utah, by G.W. Freethey, L.E. Spangler, and W.J. Monheiser, U.S. Geological Survey Water-Resources Investigations Report 92-4085.

Hydrology and potential for ground-water development in southeastern Tooele Valley and adjacent areas in the Oquirrh Mountains, Tooele County, Utah, by B.J. Stolp, Utah Department of Natural Resources Technical Publication No. 107.

Selected hydrologic data for the Bonneville Salt Flats and Pilot Valley, western Utah, 1991-93, by J. L. Mason, W.C. Brothers, L.J. Gerner, and P.S. Muir, U.S. Geological Survey Open-File Report No. 95-104.

Using geochemical data to identify sources of salinity to the freshwater Navajo aquifer in southeastern Utah, by D.L. Naftz, L.E. Spangler, and Z.E. Peterman, U.S. Geological Survey Fact Sheet 95-95.

## UTAH'S GROUND-WATER RESERVOIRS

Small amounts of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The areas of ground-water development discussed in this report are shown in figure 1 and listed in table 1. Relatively few wells outside of these areas yield large supplies of water of suitable chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rock. Consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that penetrate consolidated rock are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah withdraw water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap water in unconsolidated deposits are in large intermountain basins that have been partly filled with rock material eroded from the adjacent mountains.

## SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1994 was about 933,000 acre-feet (table 2), which is about 139,000 acre-feet more than the revised estimate for 1993 and 123,000 acre-feet more than the average annual withdrawal for 1984-93 (table 3). The average annual withdrawal during 1990-94 was about 899,000 acre-feet, which is 113,000 acre-feet more than during the preceding 5-year period, 1985-89 (table 2).

Withdrawals in 1994 for four water-use categories: (1) irrigation, (2) industry, (3) public supply, and (4) domestic and stock, increased from the revised 1993 totals. Withdrawals for irrigation were about 532,000 acre-feet (table 2), which is 73,000 acre-feet more than for 1993 and represent the largest increase in the categories. Withdrawals for public supply increased about 54,000 acre-feet from about 164,000 acre-feet in 1993 to an estimated 218,000 acre-feet in 1994. Withdrawals in 1994 for industrial use and domestic and stock were each about 66,000 acre-feet and increased 5,000 and 4,000 acre-feet, respectively, from 1993.

Ground-water withdrawals increased from 1993 to 1994 in all of the 16 significant areas of ground-water development referred to in this report (table 2). Salt Lake Valley withdrawals increased about 26,000 acre-feet, the largest increase of the 16 areas of ground-water development; Utah and Goshen Valley withdrawals increased about 25,000 acre-feet compared with 1993 withdrawals. The 1994 withdrawals exceeded the average annual withdrawals for 1984-93 in 13 of the 16 areas. Average annual withdrawals during 1990-94 in 13 of the 16 areas exceeded average annual withdrawals for the preceding 5-year period, 1985-89. In those 13 areas, the average difference is an increase of about 10,000 acre-feet for 1990-94 compared with 1985-89; and in the remaining 3 areas, the average difference is a decrease of about 7,000 acre-feet.

The amount of water withdrawn from wells is related to demand and availability of water from other sources, which, in turn, are partly related to local climatic conditions. Precipitation during calendar year 1994 at 21 of 32 weather stations included in this report (National Oceanic and Atmospheric Administration, 1993-94) was greater than the long-term average. The largest positive departure from average in 1994 is the 3.90 inches above average recorded at Oak City, and the largest negative departure from average is the 5.90 inches recorded at Timpanogos Cave, east of Lehi. Average annual precipitation during 1990-94 was more than the preceding 5-year period, 1985-89, at 20 of the 32 weather stations. The average difference between the 5-year periods at those 20 stations is 0.92 inch. The average difference for the remaining 12 stations, where the average annual precipitation during 1990-94 was less than during 1985-89 is 0.80 inch.

Increased withdrawals during 1990-95, as compared with withdrawals during 1985-89, resulted in large areas of ground-water-level declines in all of the significant areas of ground-water development in Utah. The maximum decline, nearly 48 feet, occurred in a well about 2 miles northwest of Parowan. However, the generally greater-than-average precipitation during 1990-94, as compared with 1985-89, resulted in more recharge to the ground-water reservoirs in some areas. From 1990 to 1995, both water-level rises and declines occurred in 14 of the 16 significant areas of ground-water development. Rises occurred in large parts of Cache Valley, the East Shore area, Salt Lake Valley, Utah Valley, Central Virgin River and "other areas" (Cedar Valley in Utah County and Sanpete Valley). The highest water-level rises occurred in the East Shore area, about 26 feet in a well about 3 miles northeast of Layton, and in the Beryl-Enterprise area, about 28 feet in a well north of Enterprise. No rises in water levels were observed from March 1990 to March 1995 in Juab Valley or Sevier Desert (shallow and deep aquifers).

A total of 1,210 wells were constructed during 1994, as determined from reports by well drillers filed with the Utah Division of Water Rights (table 2). This is 33 more than was reported for 1993 and 108 more than was reported for 1992. Of the 1,210 wells constructed in 1994, 727 wells were for new appropriations of ground water and 95 were replacement wells. The remaining 388 wells include test and monitoring wells. In 1994, 172 large-diameter wells (12 inches or more) were constructed principally for withdrawal of water for public supply, irrigation, and industrial use.

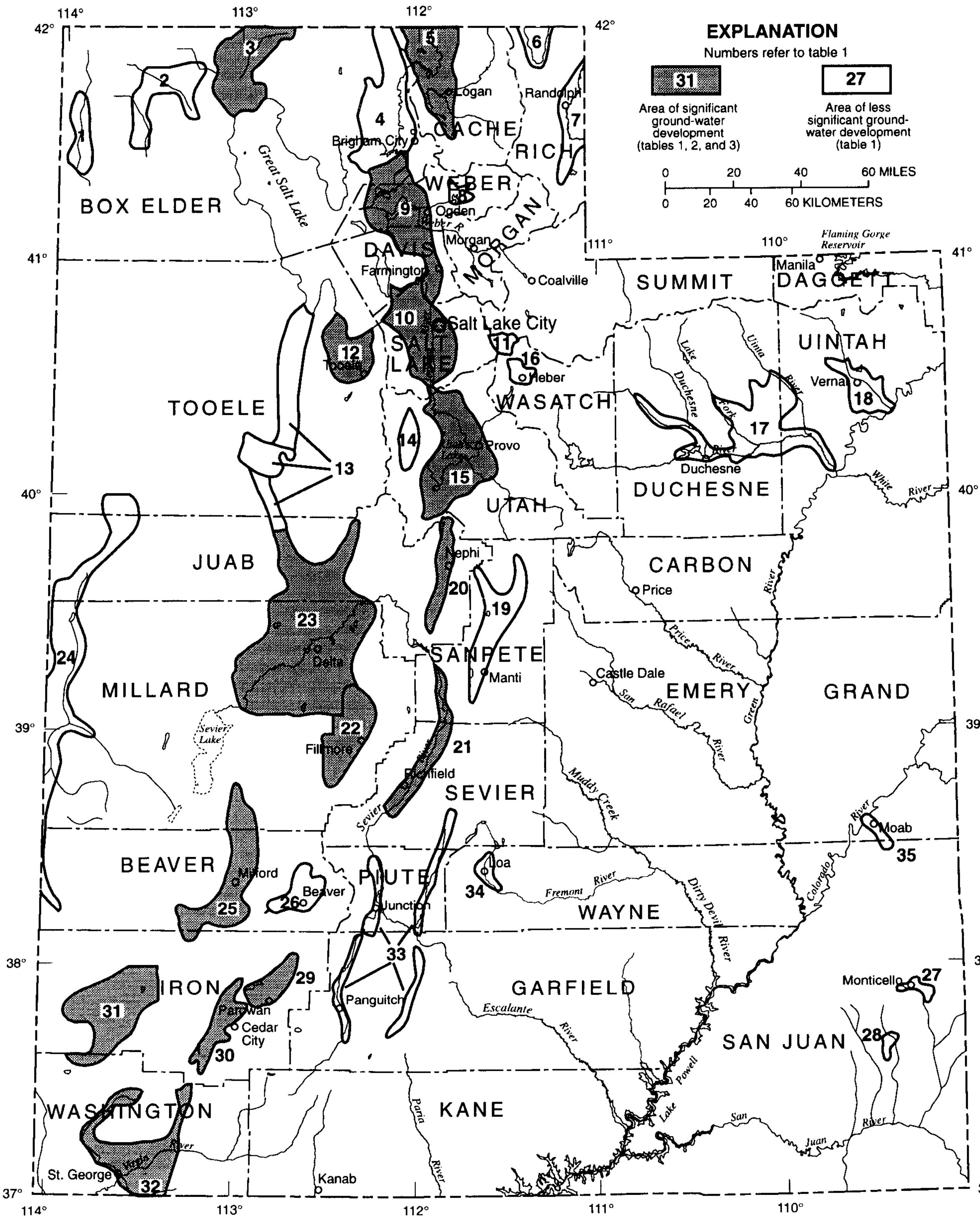



**Figure 1.** Areas of ground-water development in Utah specifically referred to in this report.

**Table 1.** Areas of ground-water development in Utah specifically referred to in this report

| Number in figure 1 | Area | Principal types of water-bearing rocks |
|---|---|---|
| 1 | Grouse Creek Valley | Unconsolidated. |
| 2 | Park Valley | Do. |
| 3 | Curlew Valley | Unconsolidated and consolidated. |
| 4 | Malad-lower Bear River valley | Unconsolidated. |
| 5 | Cache Valley | Do. |
| 6 | Bear Lake valley | Do. |
| 7 | Upper Bear River valley | Do. |
| 8 | Ogden Valley | Do. |
| 9 | East Shore area | Do. |
| 10 | Salt Lake Valley | Do. |
| 11 | Park City area | Unconsolidated and consolidated. |
| 12 | Tooele Valley | Unconsolidated. |
| 13 | Dugway area | Do. |
| | Skull Valley | Do. |
| | Old River Bed | Do. |
| 14 | Cedar Valley, Utah County | Do. |
| 15 | Utah and Goshen Valleys | Do. |
| 16 | Heber Valley | Do. |
| 17 | Duchesne River area | Unconsolidated and consolidated. |
| 18 | Vernal area | Do. |
| 19 | Sanpete Valley | Do. |
| 20 | Juab Valley | Unconsolidated. |
| 21 | Central Sevier Valley | Do. |
| 22 | Pahvant Valley | Do. |
| 23 | Sevier Desert | Unconsolidated. |
| 24 | Snake Valley | Do. |
| 25 | Milford area | Do. |
| 26 | Beaver Valley | Do. |
| 27 | Monticello area | Consolidated. |
| 28 | Blanding area | Do. |
| 29 | Parowan Valley | Unconsolidated and consolidated. |
| 30 | Cedar Valley, Iron County | Unconsolidated. |
| 31 | Beryl-Enterprise area | Do. |
| 32 | Central Virgin River area | Unconsolidated and consolidated. |
| 33 | Upper Sevier Valleys | Unconsolidated. |
| 34 | Upper Fremont River Valley | Unconsolidated and consolidated. |
| 35 | Spanish Valley | Do. |

**Table 2.** Number of wells constructed and withdrawal of water from wells in Utah

Number of wells constructed in 1994—Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes test wells and replacement wells.
Diameter of 12 inches or more—Constructed for irrigation, industry, or public supply.
Estimated withdrawals from wells—
1993 total: From Allen and others (1994, table 2), as revised.
1985-89 and 1990-94 average: Calculated from previous reports of this series and also include some previously unpublished revisions.

| | Number in figure 1 | Number of wells constructed in 1994 | | Estimated withdrawals from wells (acre-feet) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1994 | | | | | 1993 | 1985-89 | 1990-94 |
| | | Total | Diameter of 12 inches or more | Irrigation | Industry | Public supply | Domestic and stock | Total (rounded) | total (rounded) | average (rounded) | average (rounded) |
| Curlew Valley | 3 | 7 | 1 | 41,000 | 0 | 50 | 50 | 41,000 | 35,000 | 29,000 | 40,000 |
| Cache Valley | 5 | 77 | 11 | 13,900 | 6,500 | 9,100 | 1,400 | 31,000 | 23,000 | 27,000 | 30,000 |
| East Shore area | 9 | 227 | 34 | [1]25,700 | 4,000 | 25,200 | 5,000 | 60,000 | 56,000 | 66,000 | 62,000 |
| Salt Lake Valley | 10 | 105 | 19 | 2,800 | [2]26,200 | 85,800 | 27,000 | 142,000 | 116,000 | 132,000 | 135,000 |
| Tooele Valley | 12 | 56 | 5 | [1]25,400 | 350 | 5,000 | 300 | 31,000 | 22,000 | 24,000 | 29,000 |
| Utah and Goshen Valleys | 15 | 105 | 4 | 50,800 | 3,000 | 39,900 | 20,200 | 114,000 | 89,000 | 100,000 | 119,000 |
| Juab Valley | 20 | 3 | 1 | 24,200 | 0 | [3]980 | 350 | 26,000 | 20,000 | 19,000 | 25,000 |
| Sevier Desert | 23 | 44 | 1 | 29,900 | 4,400 | 2,100 | 300 | 37,000 | 31,000 | 14,000 | 34,000 |
| Central Sevier Valley | 21 | [4]35 | 4 | 16,700 | 100 | 700 | 2,200 | 20,000 | 19,000 | 18,000 | 19,000 |
| Pahvant Valley | 22 | 3 | 2 | 92,700 | 0 | 480 | 100 | 93,000 | 87,000 | 68,000 | 86,000 |
| Cedar Valley, Iron County | 30 | 38 | 12 | 28,800 | 450 | 4,200 | 350 | 34,000 | 33,000 | 22,000 | 33,000 |
| Parowan Valley | 29 | 5 | 2 | [5]29,000 | 0 | 1,100 | 250 | 30,000 | 28,000 | 24,000 | 30,000 |
| Escalante Valley | | | | | | | | | | | |
| Milford area | 25 | 14 | 11 | 52,400 | [6]7,150 | 870 | 250 | 61,000 | 50,000 | 45,000 | 51,000 |
| Beryl-Enterprise area | 31 | 27 | 13 | 83,800 | 600 | 470 | 750 | 86,000 | 78,000 | 93,000 | 80,000 |
| Central Virgin River area | 32 | 14 | 6 | 2,500 | 100 | 10,800 | 250 | 14,000 | 13,000 | 20,000 | 16,000 |
| Other areas [7,8] | | 450 | 46 | 62,200 | 13,200 | 31,000 | 6,900 | 113,000 | [9]94,000 | 85,000 | 110,000 |
| Total (rounded) | | [10]1,210 | 172 | 582,000 | 66,000 | 218,000 | 66,000 | 933,000 | [9]794,000 | 786,000 | 899,000 |

[1] Includes some domestic and stock use.
[2] Includes some use for air conditioning, about 60 percent of which is reinjected into the aquifer.
[3] Includes some industrial use.
[4] Includes wells constructed in upper Sevier Valley and upper Fremont River Valley.
[5] Includes some use for stock.
[6] Withdrawal for geothermal power generation. About 99 percent was reinjected.
[7] Withdrawals are estimated minimum. See page 75 for withdrawal estimates for other areas.
[8] Includes withdrawals for upper Sevier Valley and upper Fremont River Valley that were included with central Sevier Valley in previous reports of this series.
[9] Revised.
[10] Includes 727 wells drilled for new appropriations of ground water and 95 replacement wells. Data from Utah Department of Natural Resources, Division of Water Rights.

**Table 3.** Total annual withdrawal of water from wells in significant areas of ground-water development in Utah, 1984-93
[From previous reports of this series]

| Area | Number in figure 1 | Thousands of acre-feet | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1984-93 average (rounded) |
| Curlew Valley | 3 | 20 | 27 | 26 | 29 | 34 | 29 | 43 | 37 | 44 | 35 | 32 |
| Cache Valley | 5 | 21 | 22 | 23 | 26 | 33 | 30 | 32 | 29 | 36 | 23 | 28 |
| East Shore area | 9 | 49 | 67 | 66 | 67 | 68 | 61 | 65 | 68 | 59 | 56 | 63 |
| Salt Lake Valley | 10 | 102 | 110 | 104 | 122 | 165 | 157 | 143 | 135 | 138 | 116 | 129 |
| Tooele Valley | 12 | 23 | 22 | 21 | 22 | 26 | 27 | 33 | 30 | 30 | 22 | 26 |
| Utah and Goshen Valleys | 15 | 78 | 88 | 75 | 104 | 113 | 121 | 129 | 124 | 141 | 89 | 106 |
| Juab Valley | 20 | 6 | 11 | 10 | 22 | 22 | 28 | 27 | 25 | 29 | 20 | 20 |
| Sevier Desert | 23 | 10 | 13 | 11 | 15 | 15 | 17 | 34 | 34 | 33 | 31 | 21 |
| Central Sevier Valley [1] | 21 | 16 | 17 | 18 | 18 | 17 | 18 | 18 | 18 | 19 | 19 | 18 |
| Pahvant Valley | 22 | 42 | 62 | 60 | 66 | 71 | 82 | 88 | 74 | 86 | 87 | 72 |
| Cedar Valley, Iron County | 30 | 20 | 23 | 19 | 21 | 20 | 28 | 30 | 34 | 34 | 33 | 26 |
| Parowan Valley | 29 | 22 | 25 | 24 | 22 | 20 | 29 | 31 | 32 | 31 | 28 | 26 |
| Escalante Valley | | | | | | | | | | | | |
| Milford area | 25 | 32 | 49 | 46 | 44 | 40 | 46 | 48 | 54 | 42 | 50 | 45 |
| Beryl-Enterprise area | 31 | 95 | 100 | 93 | 97 | 88 | 85 | 86 | 79 | 72 | 78 | 87 |
| Central Virgin River area [2] | 32 | 19 | 21 | 20 | 20 | 18 | 23 | 22 | 15 | 14 | 13 | 18 |
| Other areas | | 68 | 81 | 72 | 79 | 95 | 100 | 111 | 111 | 120 | [3]94 | 93 |
| Total | | 623 | 738 | 688 | 774 | 845 | 881 | 940 | 899 | 928 | [3]794 | 810 |

[1] Previously included upper Sevier and upper Fremont River valleys.
[2] Prior to 1984 included under "Other areas."
[3] Revised.

# MAJOR AREAS OF GROUND-WATER DEVELOPMENT

## CURLEW VALLEY

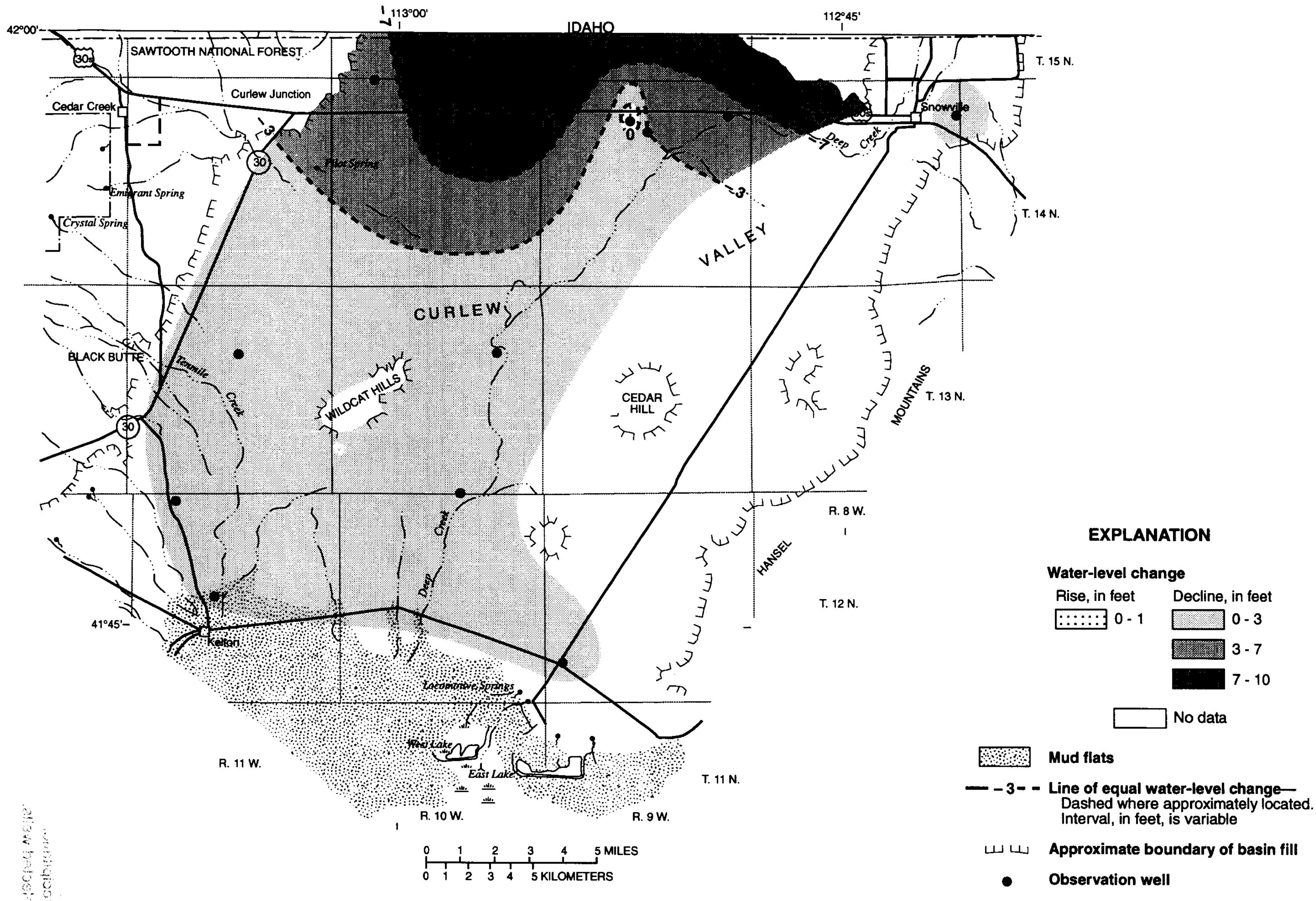
By J.D. Sory

Withdrawal of water from wells in Curlew Valley in 1994 was about 41,000 acre-feet, which is 6,000 acre-feet more than was reported for 1993 and 9,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was 40,000 acre-feet, which is 11,000 acre-feet more than was reported for the preceding 5-year period, 1985-89. All of the increased withdrawals were for irrigation.

Water levels in Curlew Valley declined from March 1990 to March 1995. The largest decline, 9.4 feet, was measured in a well about 10 miles west of Snowville (fig. 2). The declines resulted from increased withdrawals and decreased recharge from precipitation for 1990-94 as compared with the preceding 5-year period, 1985-89. Precipitation at Grouse Creek during 1994 was 7.81 inches, which is 3.05 inches less than in 1993 and 3.14 inches less than the average annual precipitation for 1959-95. The average annual precipitation during 1990-94 was 9.26 inches, which is 0.64 inch less than during the preceding 5-year period, 1985-89.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells is shown in figure 3. The hydrographs for wells (B-14-9)7bbb-1, in the irrigated areas near Snowville, and (B-12-11)16cdc-1, near the irrigated area of Kelton, are representative of ground-water levels in those areas, and show the effects of precipitation and the resulting recharge and withdrawals for irrigation.

The concentration of dissolved solids in water from well (B-12-11)4bcc-1, near Kelton, increased during 1972-94 from about 1,200 milligrams per liter to about 2,500 milligrams per liter. Two possible causes of this increase are movement of saline water toward the well because of water-level declines in the area and recharge from unconsumed irrigation water in which dissolved solids have been concentrated by evaporation.




by J. D. Sory

**Figure 2.** Map of Curlew Valley showing change of water levels from March 1990 to March 1995.

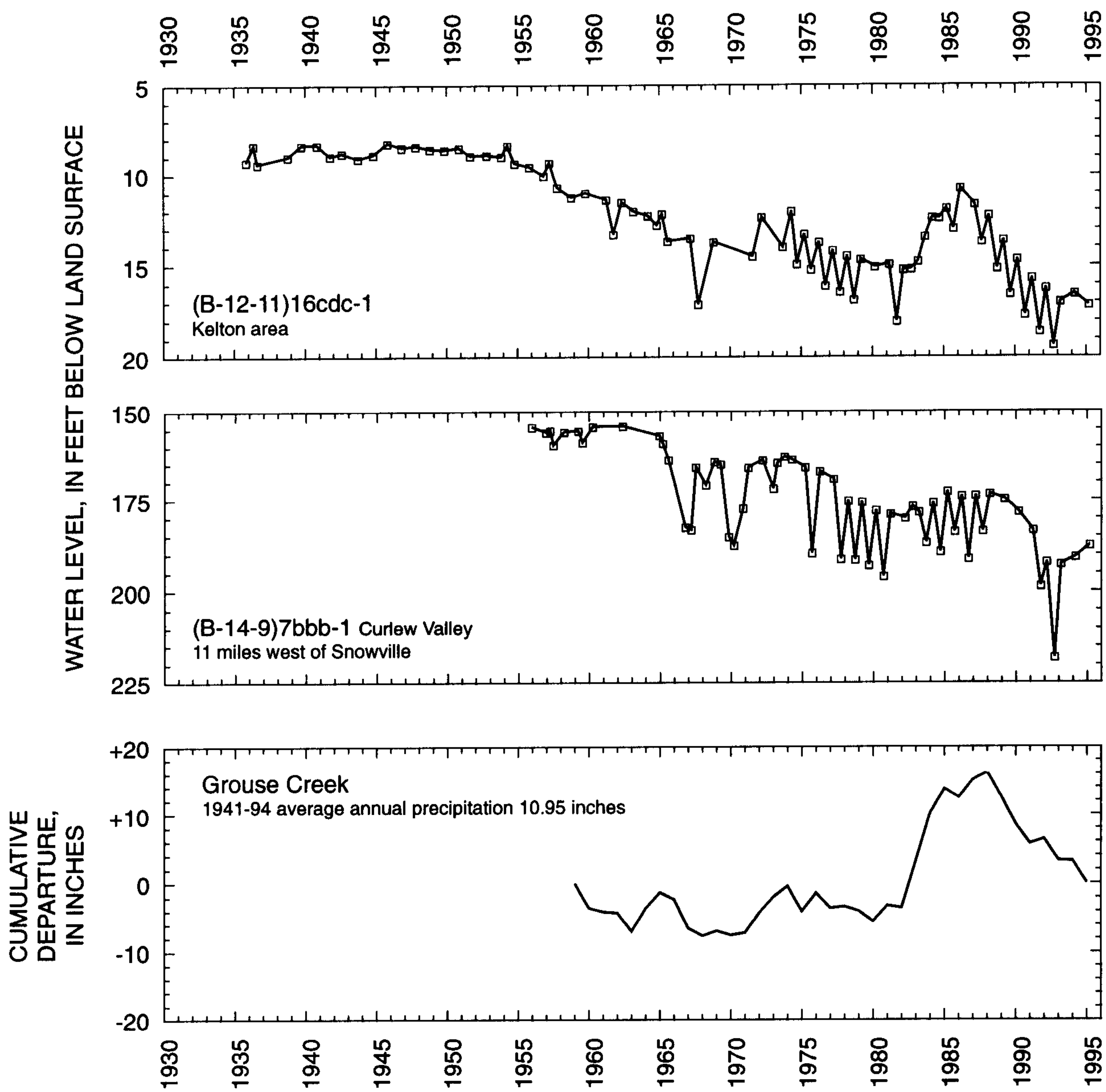



**Figure 3.** Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

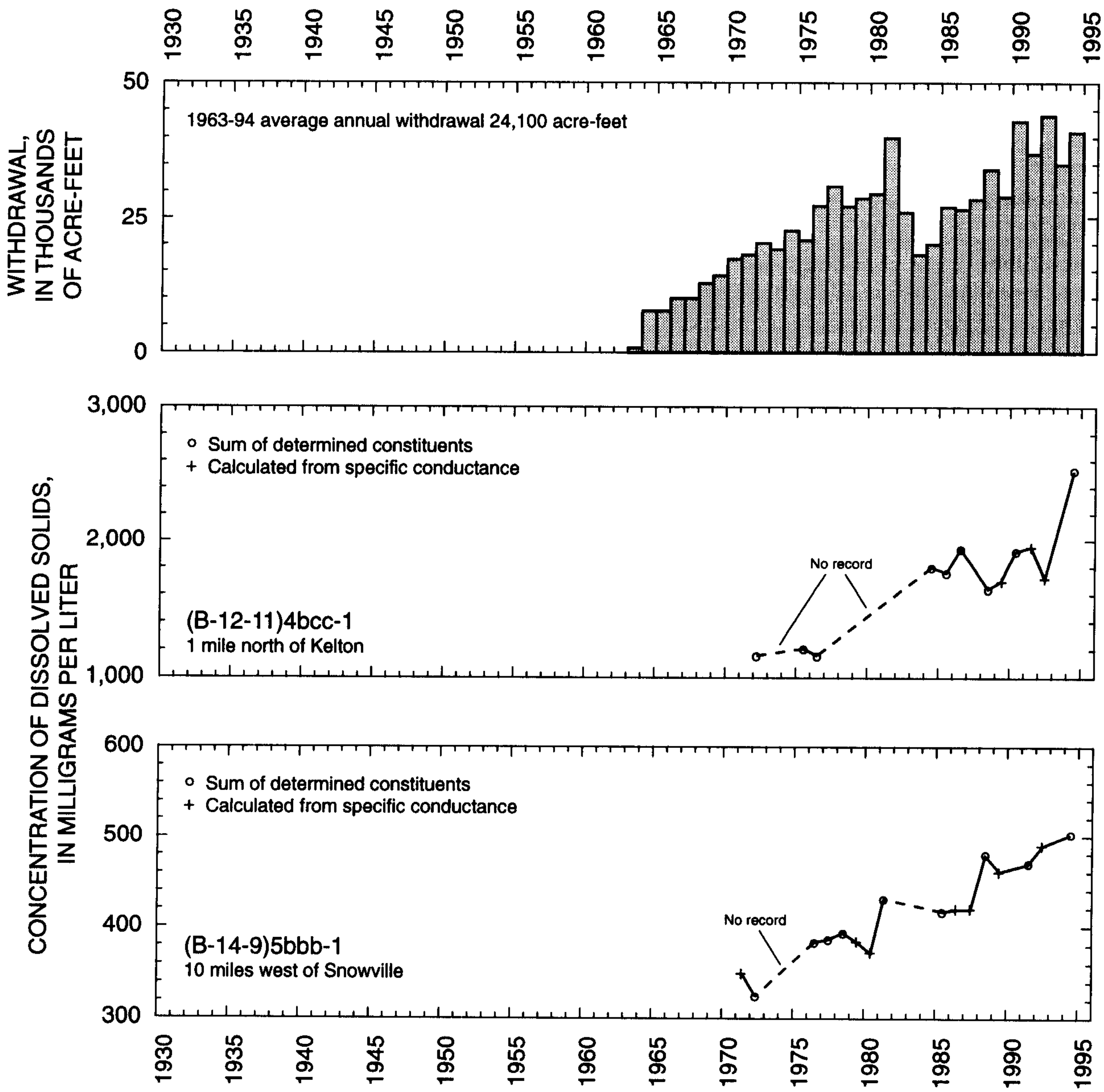



**Figure 3.** Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Grouse Creek, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

# CACHE VALLEY

## By R.B. Garrett

Withdrawal of water from wells in Cache Valley in 1994 was about 31,000 acre-feet, which is 8,000 acre-feet more than was reported for 1993 and 3,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was 30,000 acre-feet, which is 3,000 acre-feet more than was reported for the preceding 5-year period, 1985-89, mainly because of increased withdrawals for irrigation and public supply. The increased withdrawals resulted from less precipitation and available surface water during 1990-94 as compared with the preceding 5-year period, 1985-89.

Water levels generally declined from March 1990 to March 1995 in Cache Valley (fig. 4). Local areas of rises occurred near Cornish, Richmond, Paradise, and an area from Mendon extending through the middle of the valley to west of Logan. The largest decline, 3.6 feet, was measured in a well in Logan; the largest rise, 6.9 feet, was measured in a well in Richmond. The decline probably resulted from increased withdrawals for irrigation and public supply and less-than-average precipitation and streamflow during 1990-94 as compared with the preceding 5-year period, 1985-89.

The relation of water levels in wells (A-12-1)29cab-1 and (A-13-1)29adc-1, to total discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at the Logan, Utah State University (USU) station, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3 is shown in figure 5.

Total discharge of the Logan River (combined flow from the Logan River above State Dam, near Logan and Logan, Hyde Park, and Smithfield Canal at Head, near Logan) during 1994 was about 115,300 acre-feet, which is 75,600 acre-feet less than the 190,900 acre-feet of discharge during 1993 and 64 percent of the 1941-94 average annual discharge.

Precipitation at the Logan USU station was 15.24 inches in 1994. This is 5.01 inches less than the precipitation reported for 1993 and 3.30 inches less than the average annual precipitation for 1941-94. The average annual precipitation for 1990-94 was 16.99 inches, which is 1.18 inches less than during the preceding 5-year period, 1985-89.

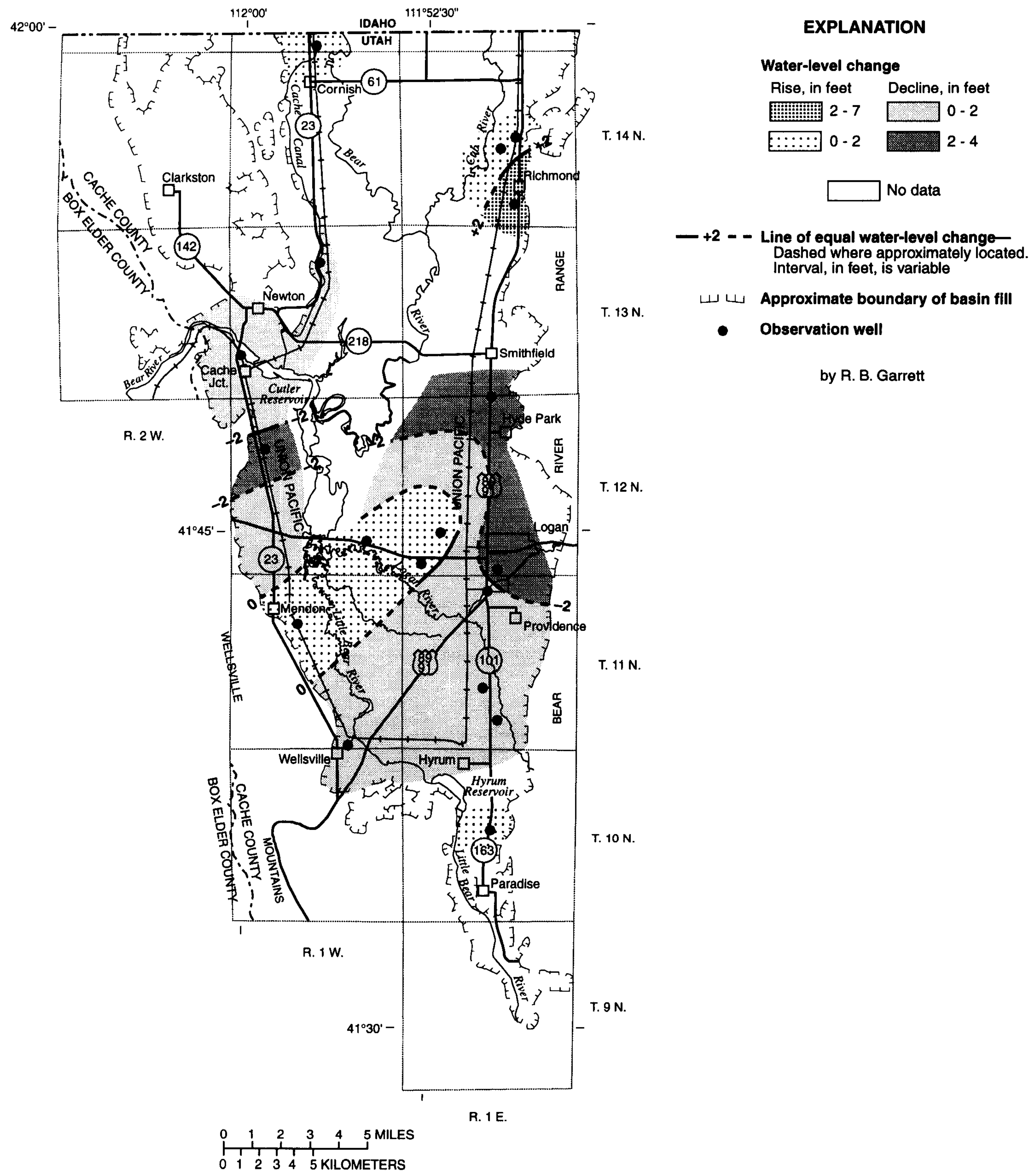



**Figure 4.** Map of Cache Valley showing change of water levels from March 1990 to March 1995.

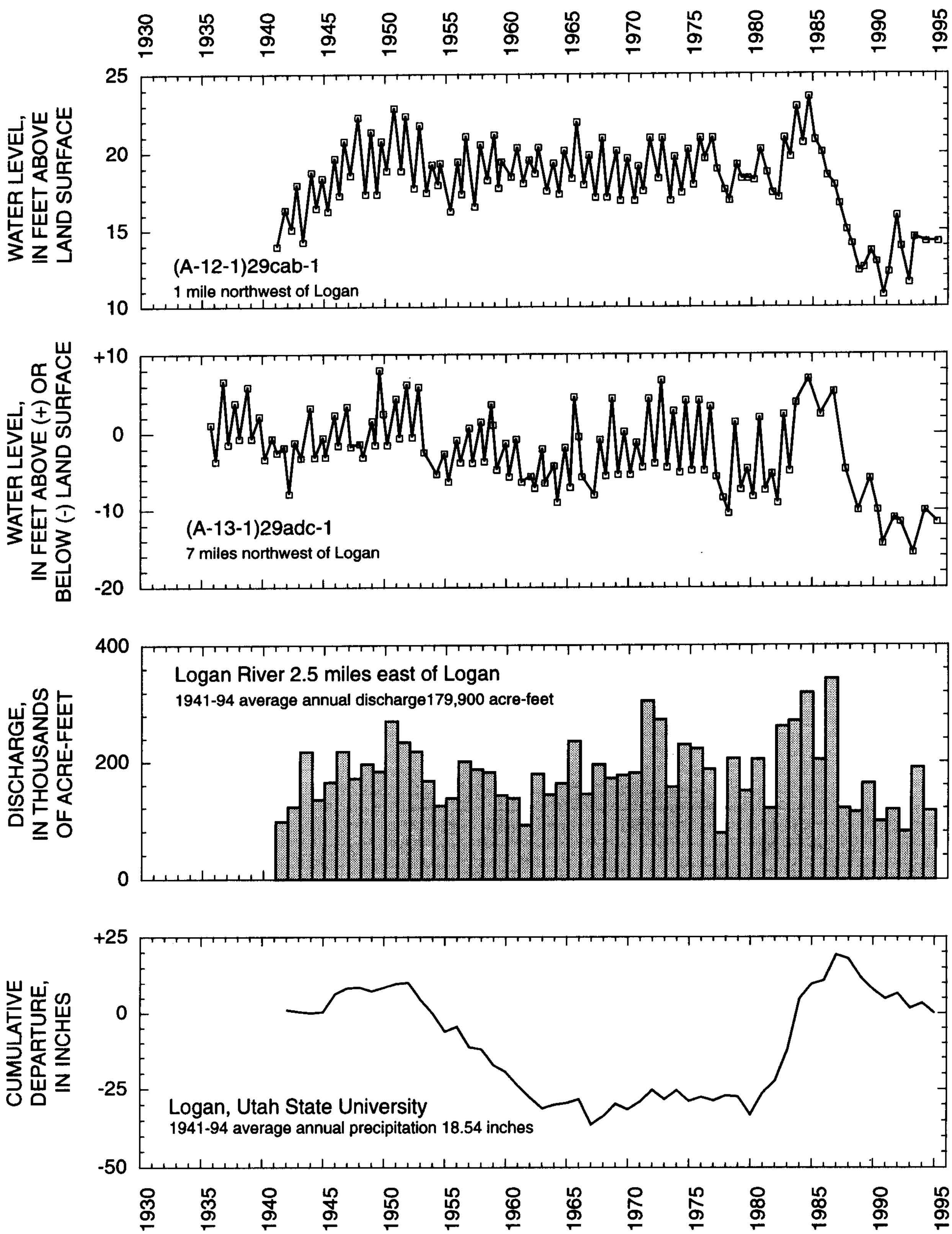



**Figure 5.** Relation of water levels in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3.

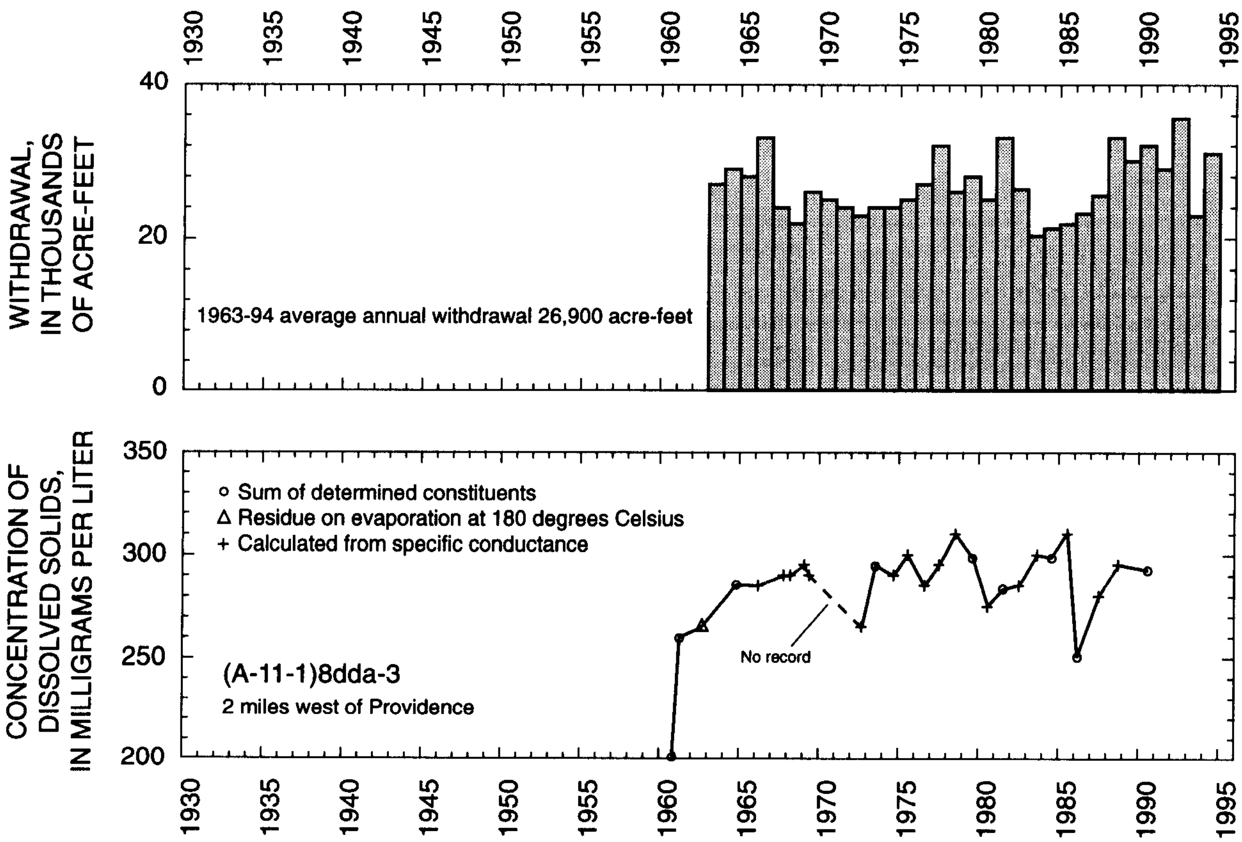



**Figure 5.** Relation of water levels in selected wells in Cache Valley to total annual discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (A-11-1)8dda-3—Continued.

## EAST SHORE AREA

### By C.B. Burden

Withdrawal of water from wells in the East Shore area in 1994 was about 60,000 acre-feet, which is 4,000 acre-feet more than was reported for 1993 and 3,000 acre-feet less than the average annual withdrawal for 1984-93 (tables 2 and 3). Withdrawal for public supply was about 25,200 acre-feet, which is 5,500 acre-feet more than in 1993. Industrial withdrawal decreased during 1994 by about 2,800 acre-feet, and irrigation withdrawal increased by about 700 acre-feet to 25,700 acre-feet. The average annual withdrawal for 1990-94 was 62,000 acre-feet, which is 4,000 acre-feet less than was reported for the preceding 5-year period, 1985-89.

Water levels generally rose from March 1990 to March 1995 in most of the East Shore area. The largest rise, 25.7 feet, occurred in a well about 4 miles northeast of Layton (fig. 6). The rise in water levels probably resulted from increased recharge from precipitation, and to a lesser extent, decreased pumpage during 1990-94 as compared with the preceding 5-year period, 1985-89. Declines in water levels occurred in the northwest and southern parts of the area. The largest decline, 10.0 feet, occurred in a well southeast of Clearfield. Declines probably resulted from increased local pumpage.

The relation of water levels in selected observation wells to cumulative departure from average annual precipitation at the Ogden Pioneer Powerhouse, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1 is shown in figure 7. Precipitation at the Ogden Pioneer Powerhouse in 1994 was 20.37 inches, which is 1.25 inches less than the average annual precipitation for 1937-94. The average annual precipitation for 1990-94 was 22.36 inches, which is 3.11 inches more than during the preceding 5-year period, 1985-89.

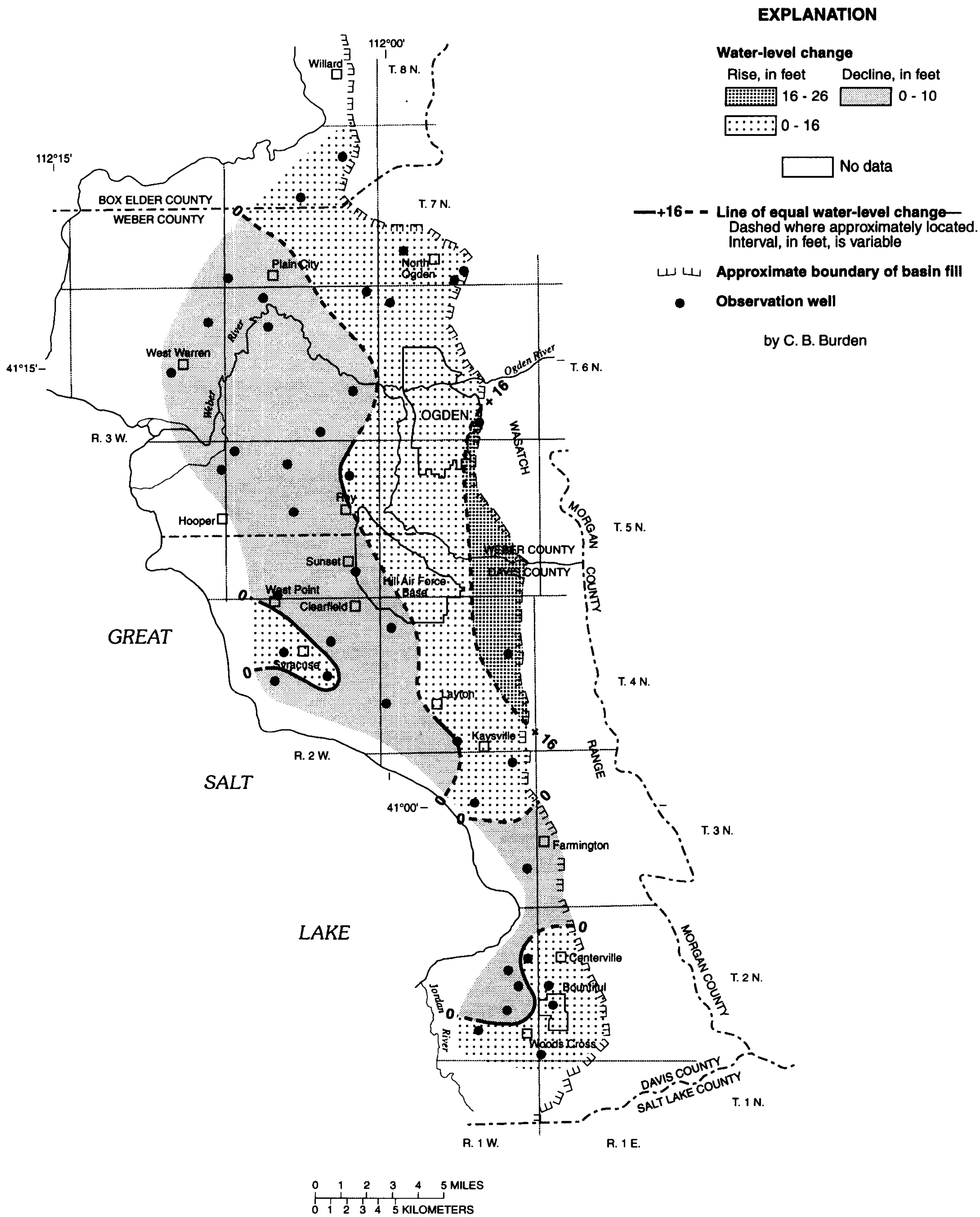



**Figure 6.** Map of the East Shore area showing change of water levels from March 1990 to March 1995.

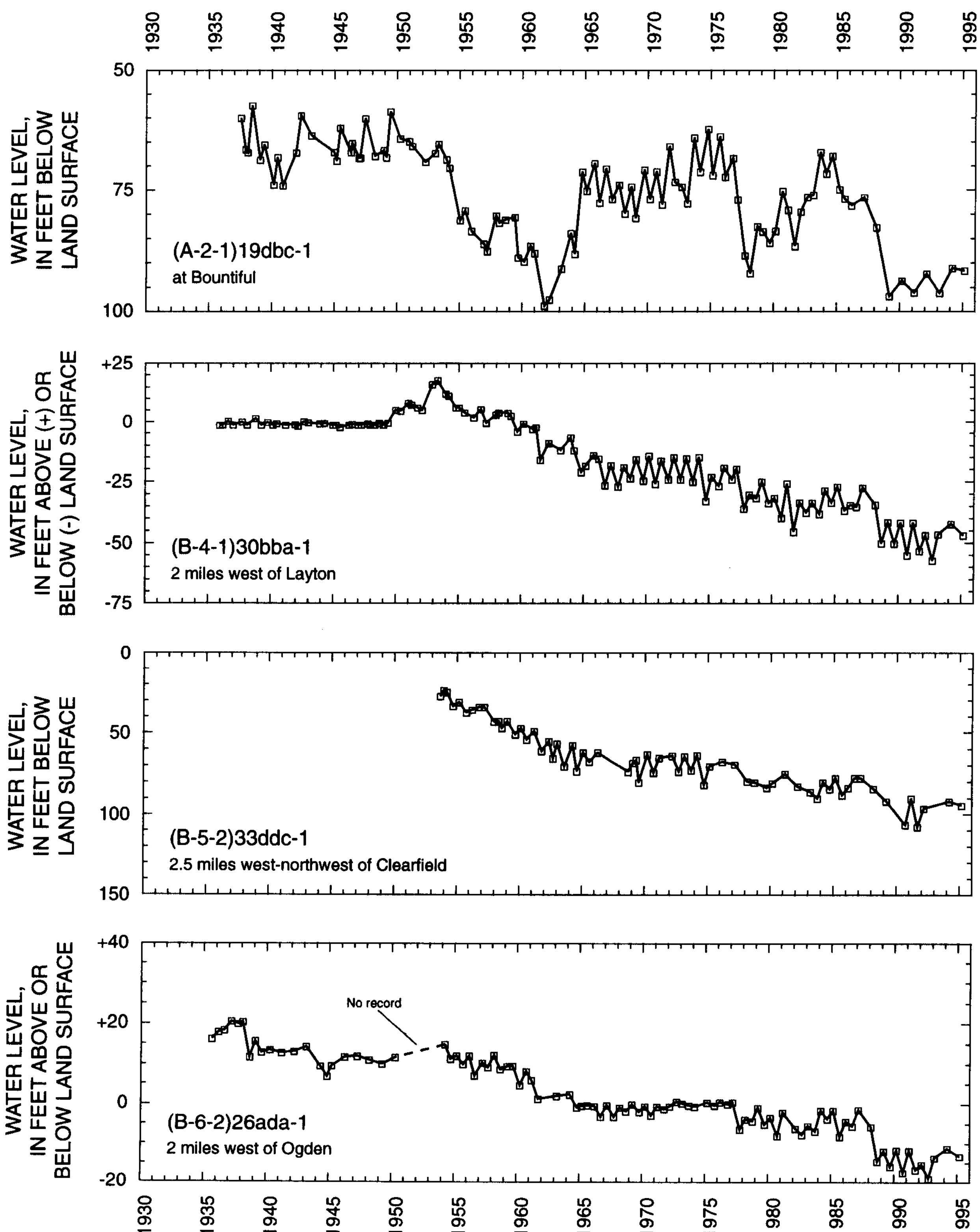



**Figure 7.** Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1.

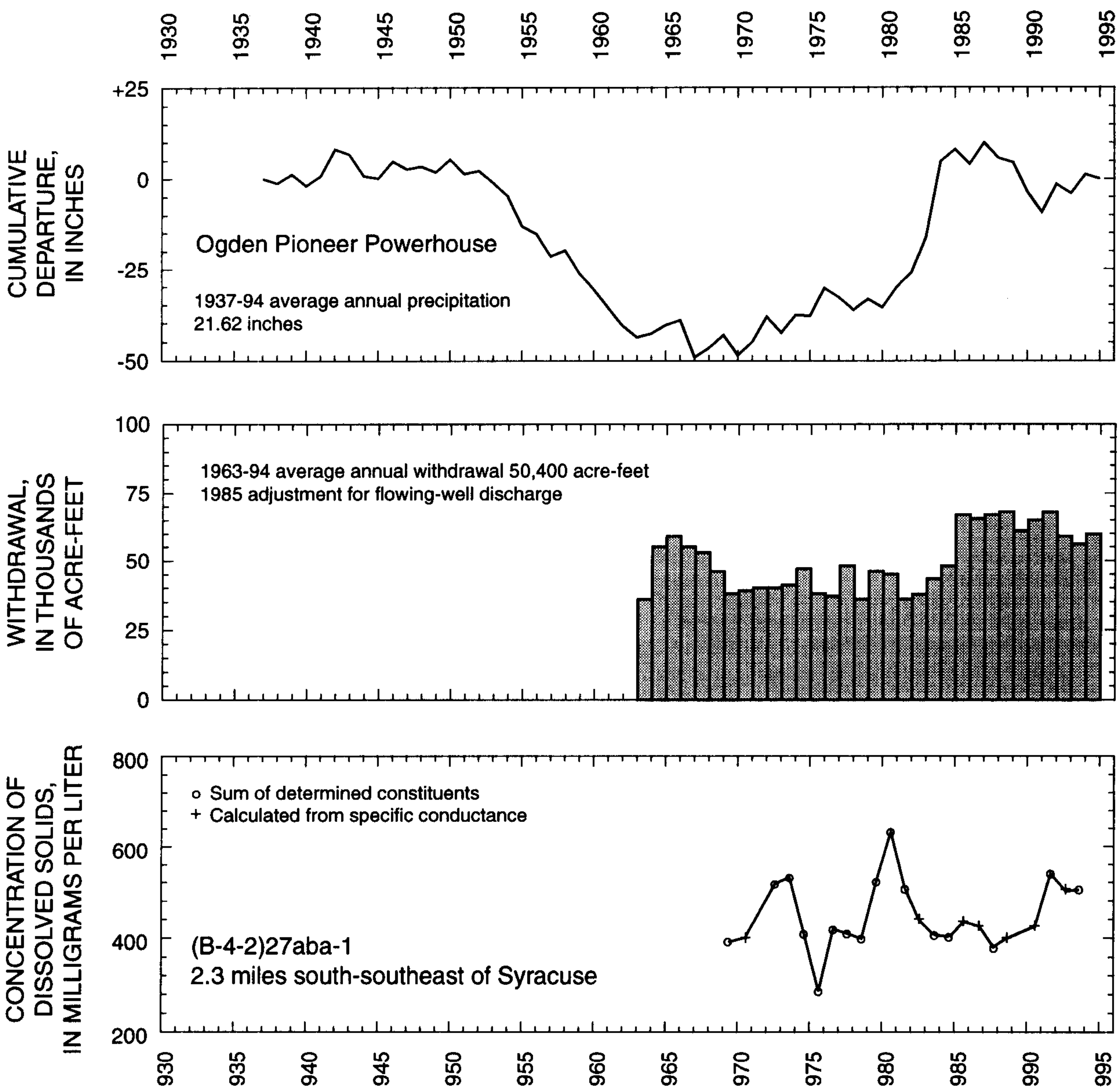



**Figure 7.** Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (B-4-2)27aba-1—Continued.

## SALT LAKE VALLEY

### By D.V. Allen

Withdrawal of water from wells in Salt Lake Valley in 1994 was about 142,000 acre-feet, which is 26,000 acre-feet more than was reported for 1993 and 13,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). Withdrawal for public supply was about 85,800 acre-feet, which is 17,000 acre-feet more than was reported in 1993. Withdrawal for industrial use in 1994 was about 26,200 acre-feet, which is 4,200 acre-feet more than was reported for 1993. The average annual withdrawal for 1990-94, about 135,000 acre-feet, is 3,000 acre-feet more than was reported for the preceding 5-year period, 1985-89.

Water levels in the principal aquifers generally declined in most of Salt Lake Valley from February 1990 to February 1995 (fig. 8). The areas of greatest decline were in the southwestern part of the valley, with the greatest decline, almost 29 feet, measured in a well near Herriman. Water-level declines probably resulted from local increases in pumpage during 1990-94. Water-level rises occurred in the northern, northeastern, and central parts of the valley. The largest rise, 11.0 feet, occurred in a well in the northern part of Salt Lake City. Water-level rises probably resulted from local decreases in pumpage during 1990-94 and increases in recharge because of greater-than-average precipitation during 1993-94.

Estimated Salt Lake County population, total annual withdrawal from wells, annual withdrawal for public supply, and annual precipitation at the Salt Lake City Weather Service Office (WSO) (International Airport) are shown in figure 9. Precipitation at the Salt Lake City WSO during 1994 was 15.28 inches, which is 0.18 inch more than the average annual precipitation for 1931-94. The average annual precipitation for 1990-94 was 14.94 inches, which is 1.13 inches less than for the preceding 5-year period, 1985-89.

The relation of water levels in selected wells completed in the principal aquifer to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well are shown in figure 10. Precipitation at Silver Lake near Brighton was 43.13 inches in 1994, which is 0.62 inch more than the average annual precipitation for 1931-94. The average annual precipitation during 1990-94 was 40.63 inches, which is 1.30 inches more than for the preceding 5-year period, 1985-89.

The chloride concentration from well (D-1-1) 7abd-6 (located in Artesian Well Park in Salt Lake City and used by many people for drinking water) was 130 milligrams per liter in July 1994, which is the highest chloride concentration previously measured at this well. Water levels in selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 11. The water level in the shallow well in Rose Park increased about 1.4 feet from February 1994 to February 1995 and about 2.4 feet from February 1990 to February 1995. A rise of about 5.2 feet occurred in well (B-1-2)31aaa-1, located about 5 miles north of Magna.

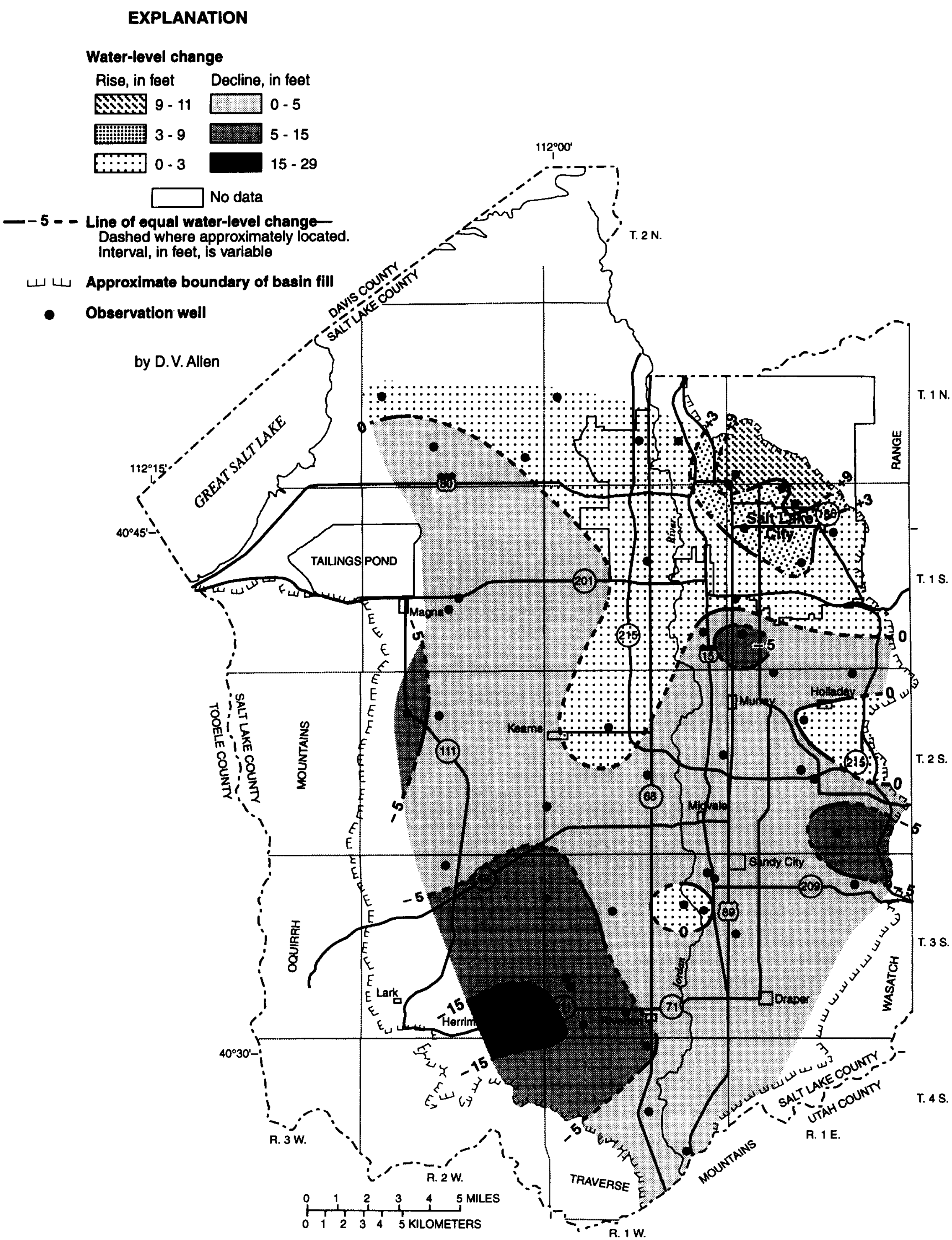



**Figure 8.** Map of Salt Lake Valley showing change of water levels in the principal aquifer from February 1990 to February 1995.

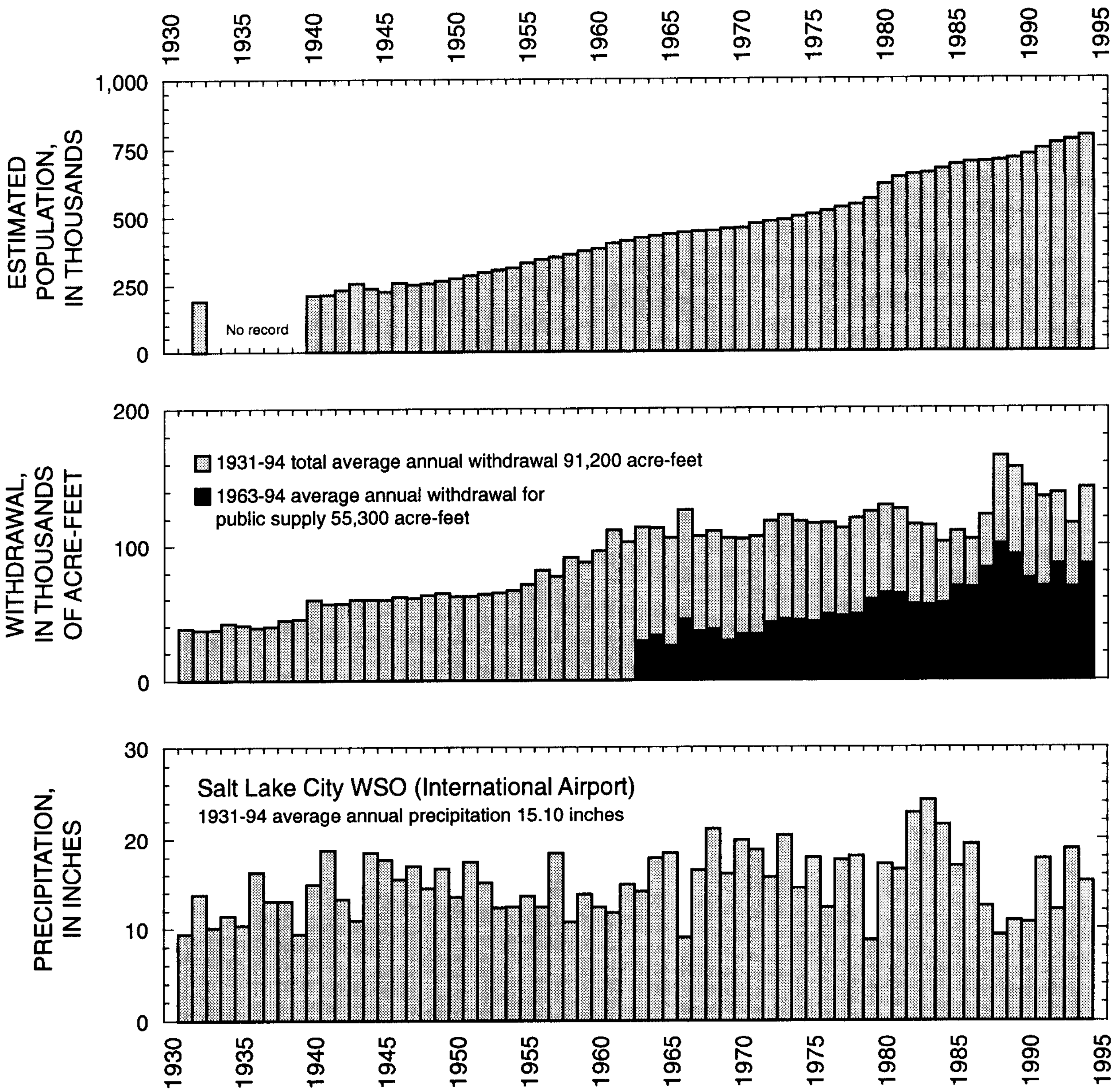



**Figure 9.** Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawals for public supply, and annual precipitation at Salt Lake City Weather Service Office (International Airport).

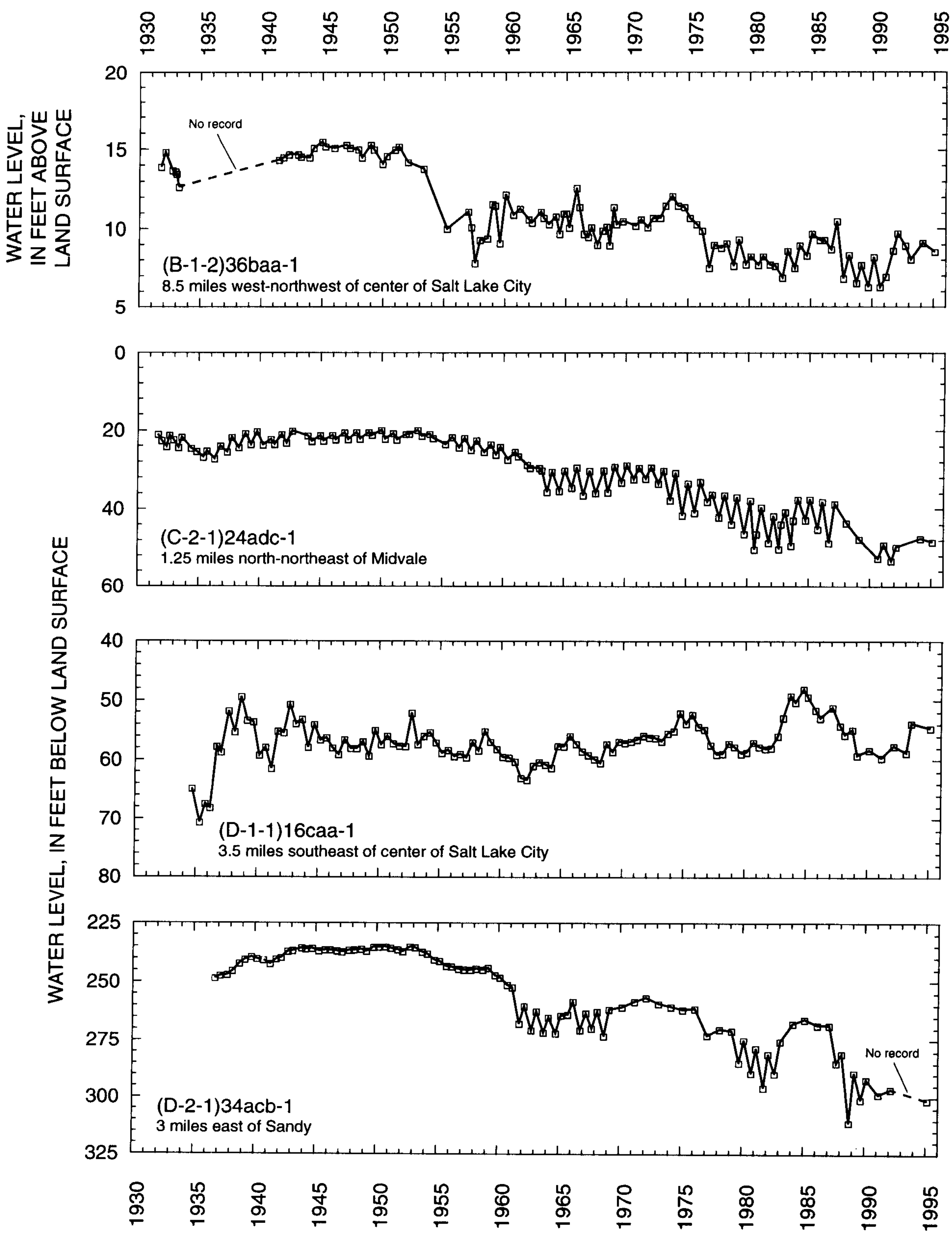



**Figure 10.** Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well.

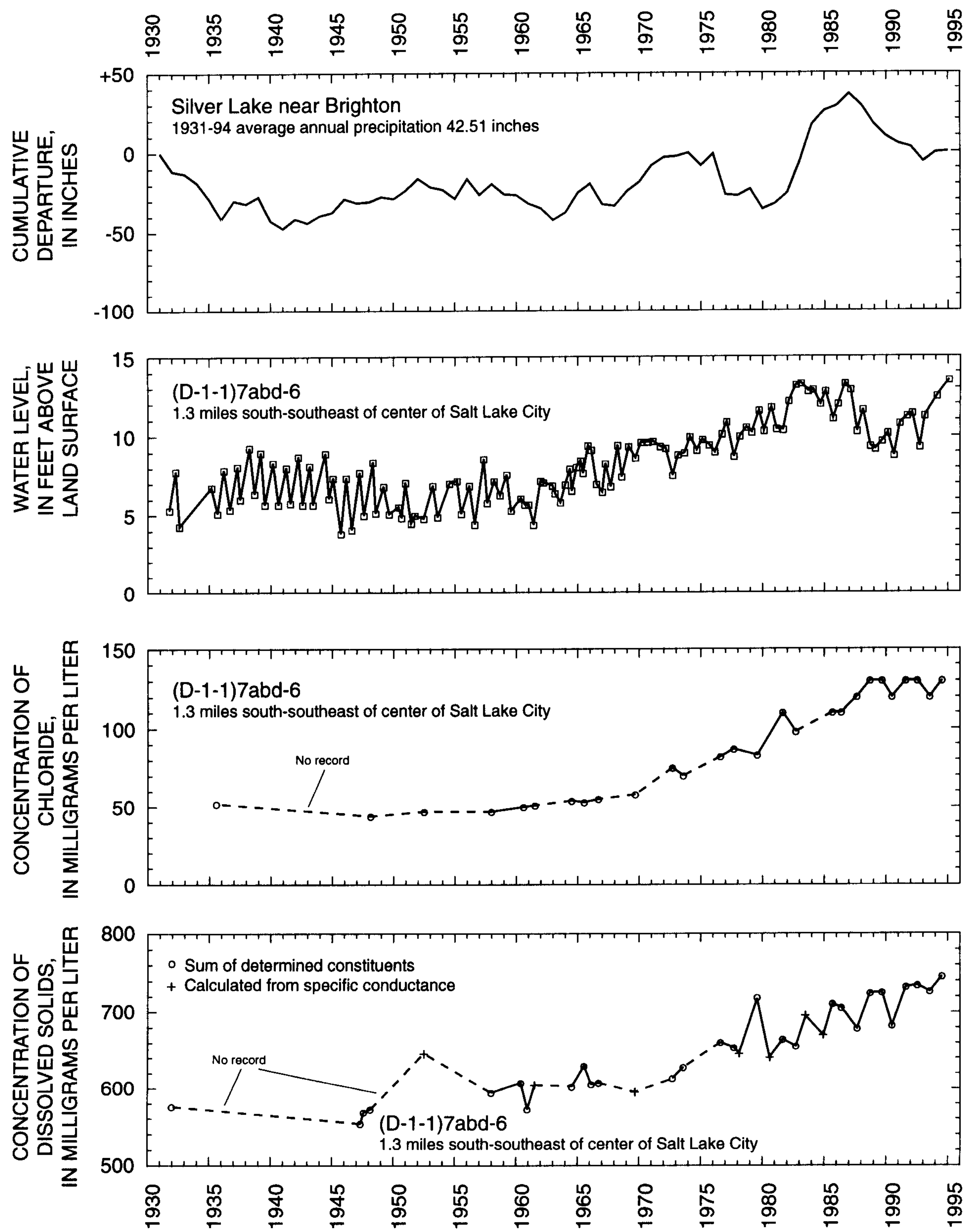



**Figure 10.** Relation of water levels in selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake near Brighton, and relation of water levels in well (D-1-1)7abd-6 to concentration of chloride and dissolved solids in water from the well—Continued.

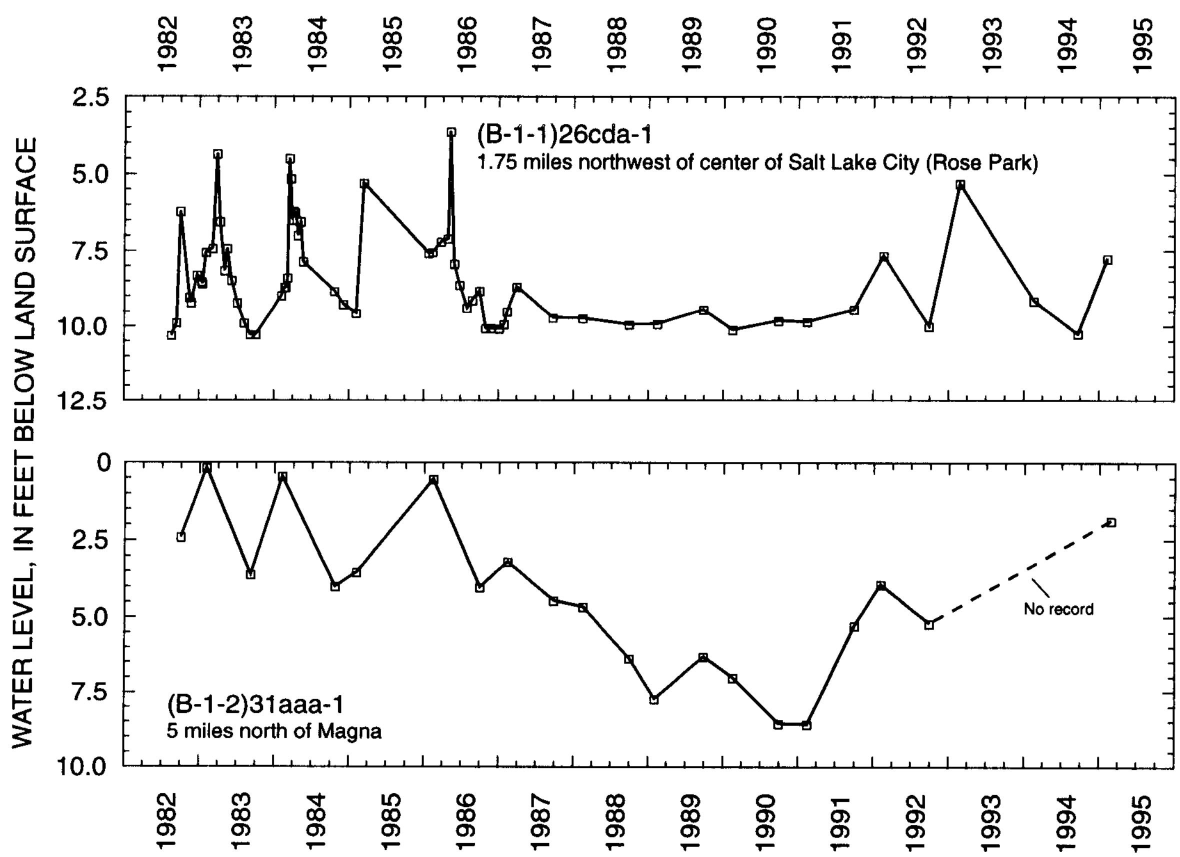



**Figure 11.** Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

## TOOELE VALLEY

By M.R. Danner

Withdrawal of water from wells in Tooele Valley in 1994 was about 31,000 acre-feet, which is 9,000 acre-feet more than was reported for 1993 and 5,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was about 29,000 acre-feet, which is 5,000 acre-feet more than was reported for the preceding 5-year period, 1985-89.

Water levels generally declined in most of Tooele Valley from March 1990 to March 1995, with the largest declines occurring in the eastern part of the valley. The largest decline, of about 27 feet, was measured in a well about 3 miles north of Tooele (fig. 12). The declines probably resulted from increased withdrawals and decreased recharge during 1990-94 as compared with the preceding 5-year period, 1985-89. The recharge rate decreased because of less precipitation during 1990-94 as compared with precipitation during the preceding 5-year period, 1985-89. Water levels rose about 1 foot in an area north of Grantsville from March 1990 to March 1995.

The relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentrations of dissolved solids in water from selected wells is shown in figure 13. Precipitation during 1994 at Tooele was 19.58 inches, which is 1.15 inches less than in 1993 and 2.17 inches more than the average annual precipitation for 1936-94. Average annual precipitation at Tooele for 1990-94 was 18.28 inches, which is 1.04 inches less than for the preceding 5-year period, 1985-89. The concentration of dissolved solids in water from well (C-2-6)23cbb-1 generally declined after 1960, especially after 1982, although no data are available for after 1992.

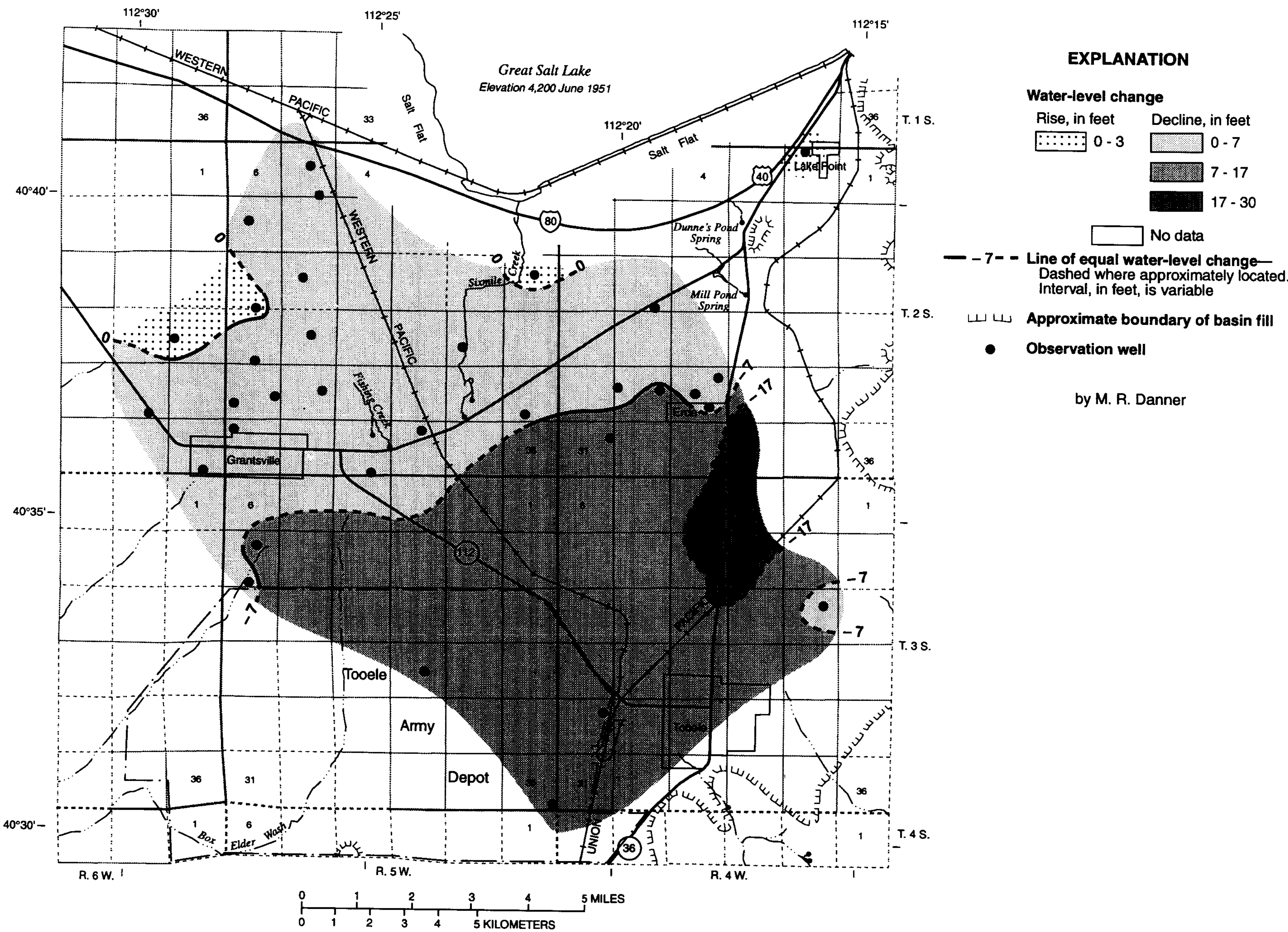



**Figure 12.** Map of Tooele Valley showing change of water levels from March 1990 to March 1995.

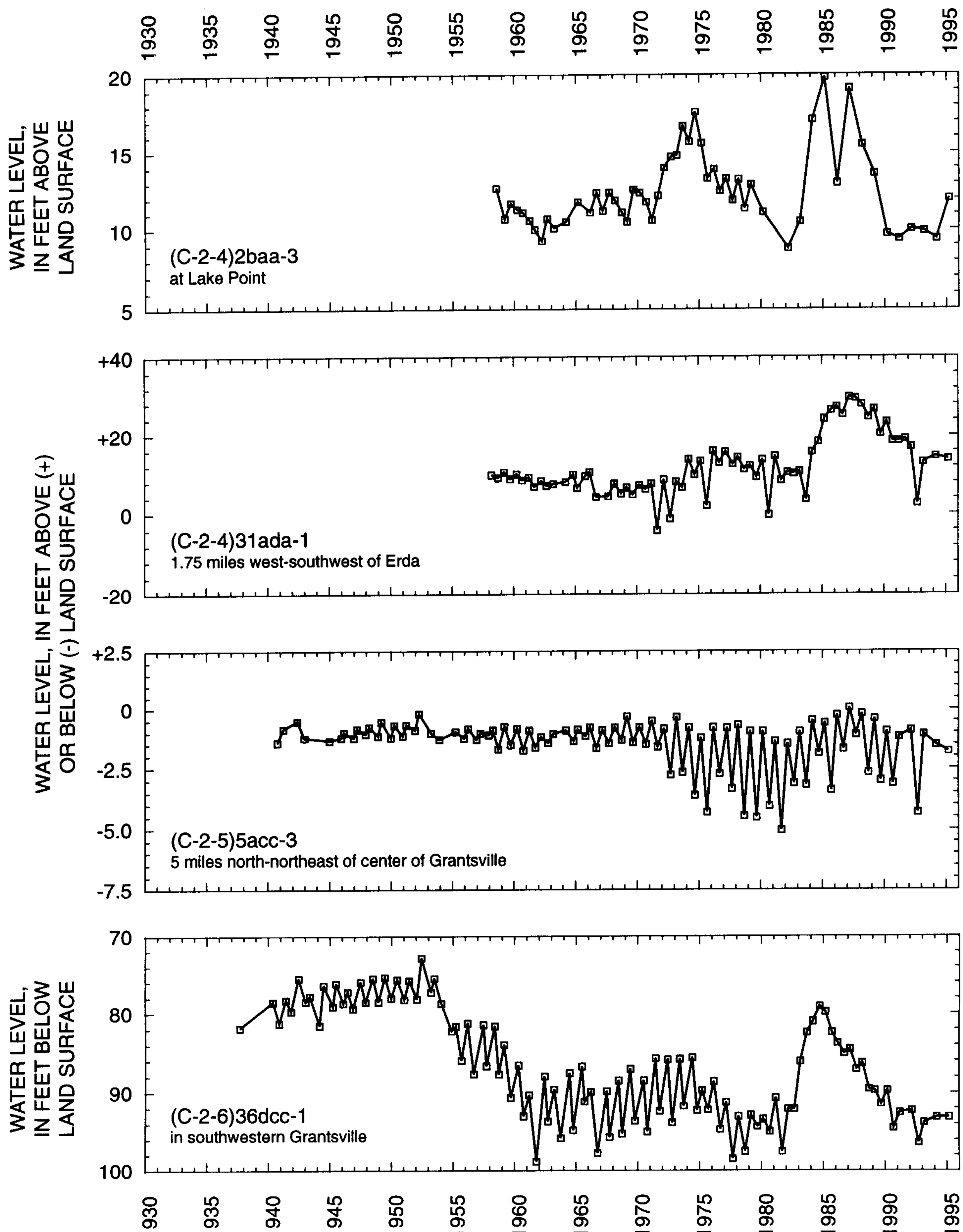



**Figure 13.** Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

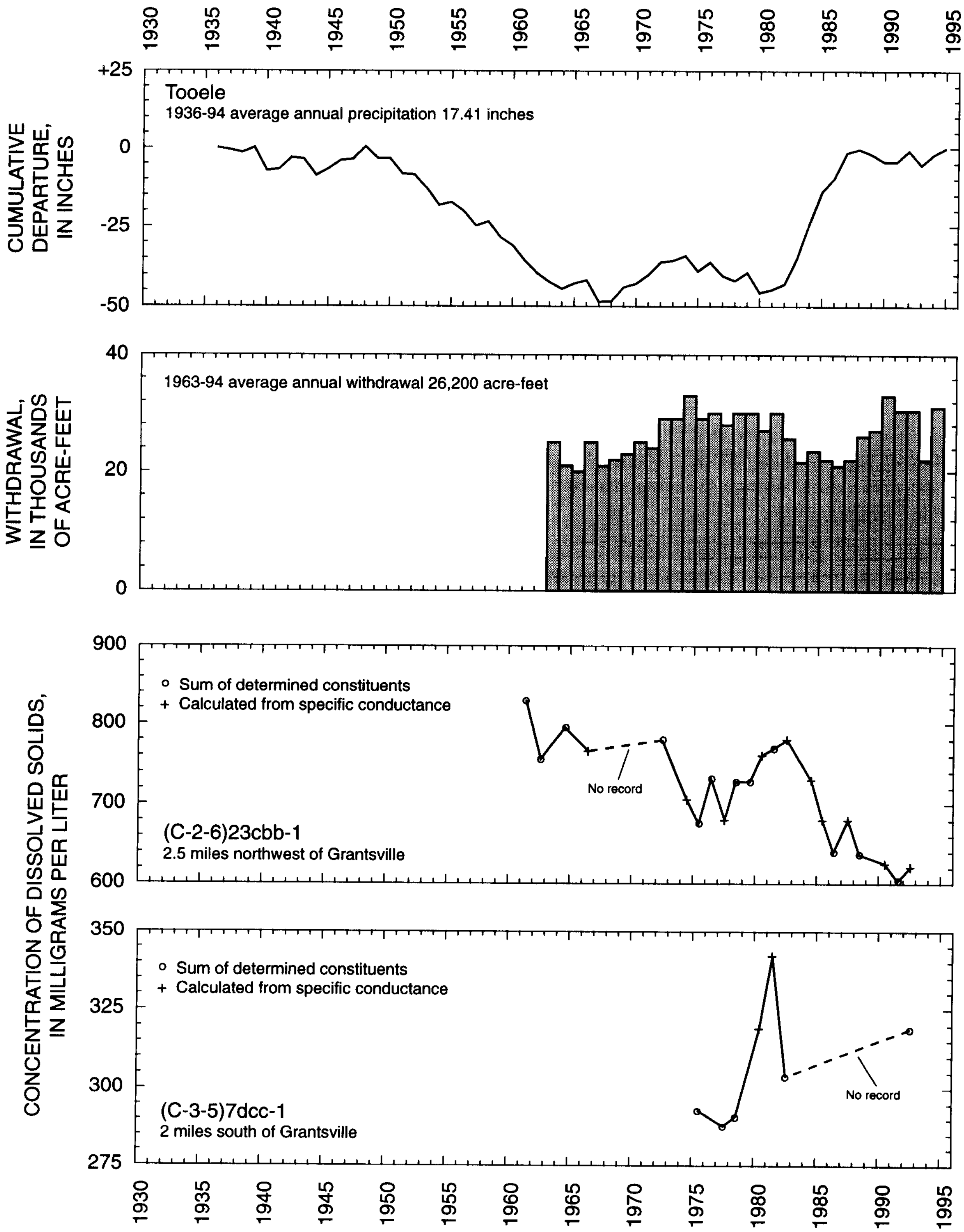



**Figure 13.** Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

## UTAH AND GOSHEN VALLEYS

By L.R. Herbert

Withdrawal of water from wells in Utah and Goshen Valleys in 1994 was about 114,000 acre-feet, which is 25,000 acre-feet more than was reported for 1993, 7,000 acre-feet less than for 1989, and 8,000 acre-feet more than the average annual withdrawal for the preceding 10-year period, 1984-93 (tables 2 and 3). The 1990-94 average annual withdrawal of about 119,000 acre-feet was 19,000 acre-feet more than for the preceding 5-year period, 1985-89. Withdrawals in northern Utah Valley were about 80,600 acre-feet, which is 24,900 acre-feet more than in 1993; withdrawals in southern Utah Valley were about 23,700 acre-feet, which is 3,200 acre-feet more than in 1993; withdrawals in Goshen Valley were about 9,700 acre-feet, which is 3,000 acre-feet less than in 1993. The total increase in withdrawals mainly was caused by increased public supply and irrigation uses.

Water levels generally rose in northern Utah Valley from March 1990 to March 1995 and generally declined in southern Utah Valley and Goshen Valley (fig. 14). The rise in water levels was caused by increased precipitation in 1994 as compared with 1989. The decline in water levels was caused by continued large withdrawals and decreased recharge from surface water during 1994 as compared with 1989. The largest decline, of about 13 feet, was observed east of Spanish Fork (fig. 15). The largest rise, of about 7 feet, occurred near Alpine.

The 1994 discharge at Spanish Fork at Castilla was about 151,000 acre-feet, which is 13,800 acre-feet less than the 1933-94 average annual discharge and 32,700 acre-feet less than in 1989. The 1994 precipitation at Timpanogos was 19.80 inches, which is 5.05 inches less than the average annual precipitation for 1947-94 and 2.90 inches less than in 1989. The 1994 precipitation at Spanish Fork Powerhouse was 22.97 inches, which is 3.73 inches more than the average annual precipitation for 1937-94 and 9.15 inches more than in 1989.

The relation of water levels in selected observation wells to cumulative departure from the average annual precipitation, to annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells is shown in figure 15. The water levels in the observation wells declined from March 1994 to March 1995, with the largest decline, of about 8 feet, in a well near Lehi. Dissolved-solids concentrations in water from observation wells generally increased from 1993-94, with the largest increase of about 110 milligrams per liter occurring in a well near Lehi. The well near Goshen was not used in 1994.

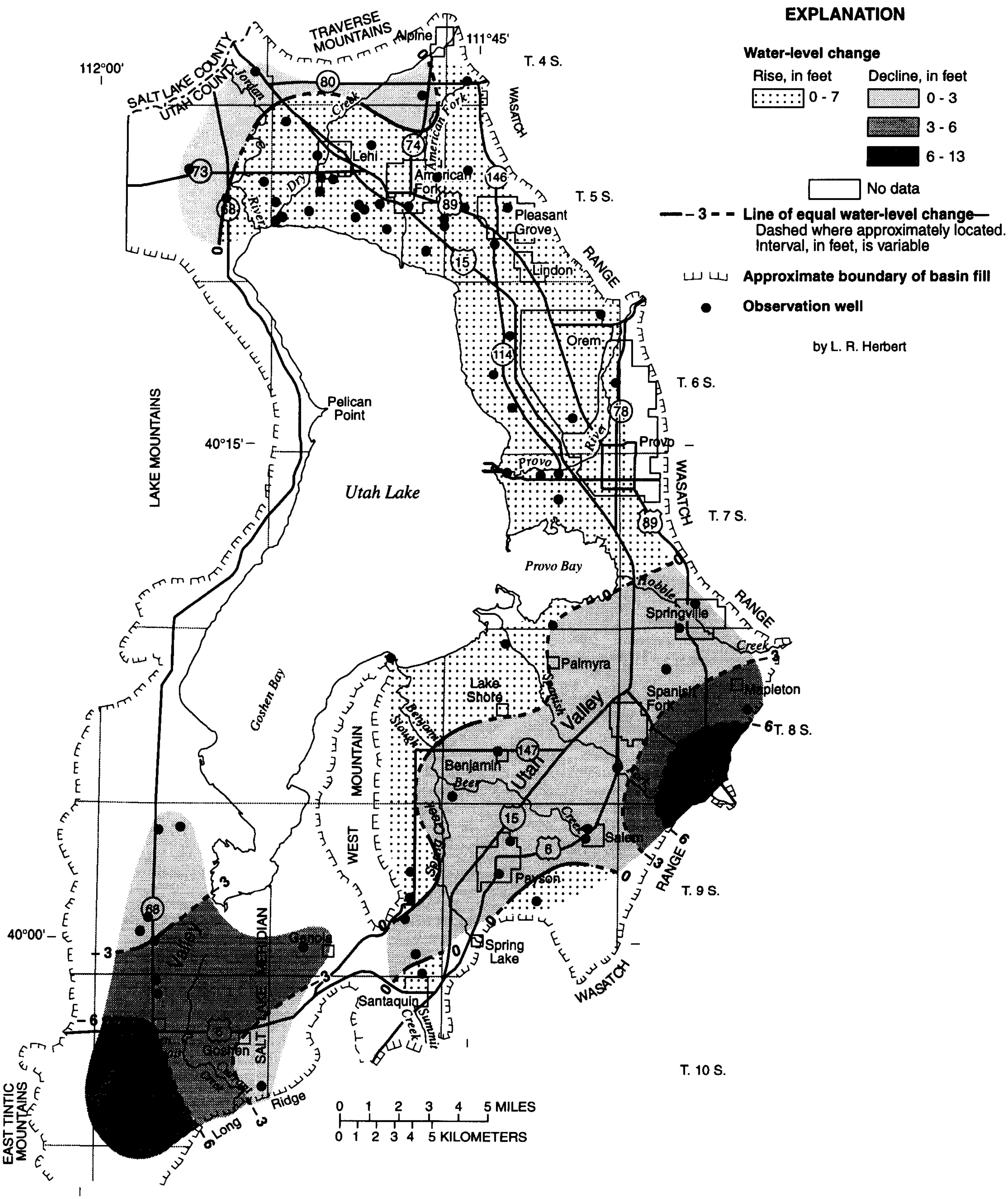



**Figure 14.** Map of Utah and Goshen Valleys showing change of water levels from March 1990 to March 1995.

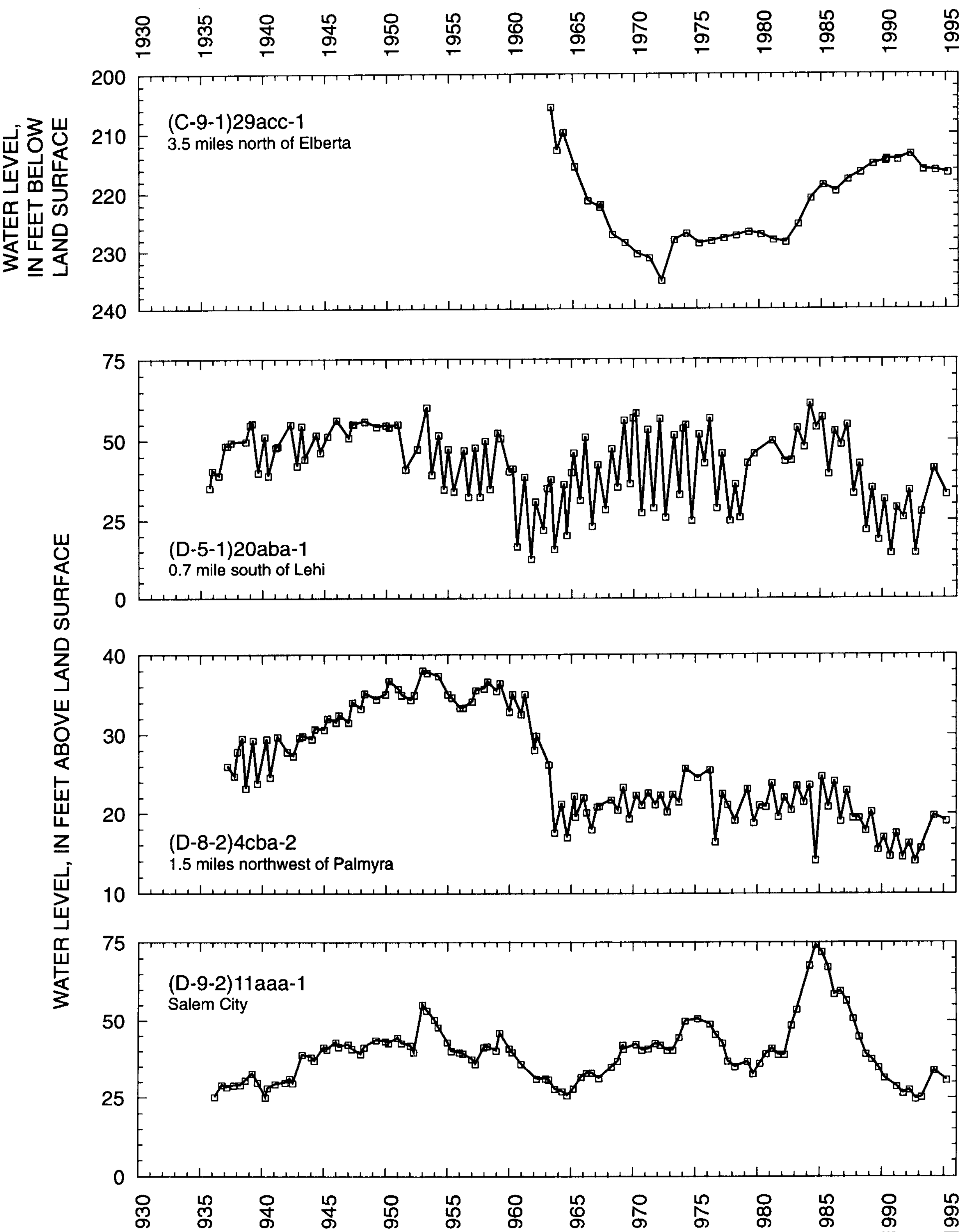



**Figure 15.** Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells.

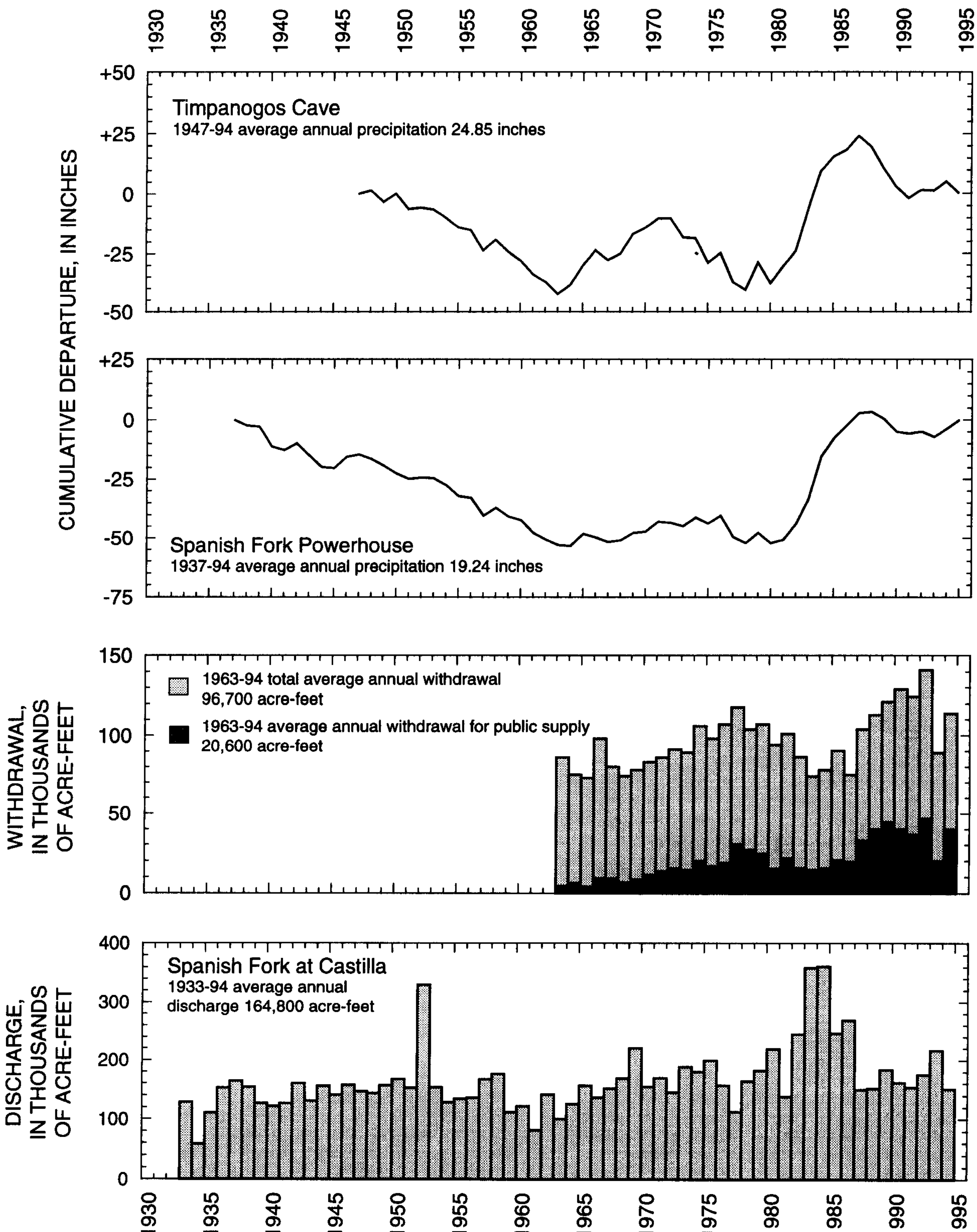



**Figure 15.** Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells—Continued.

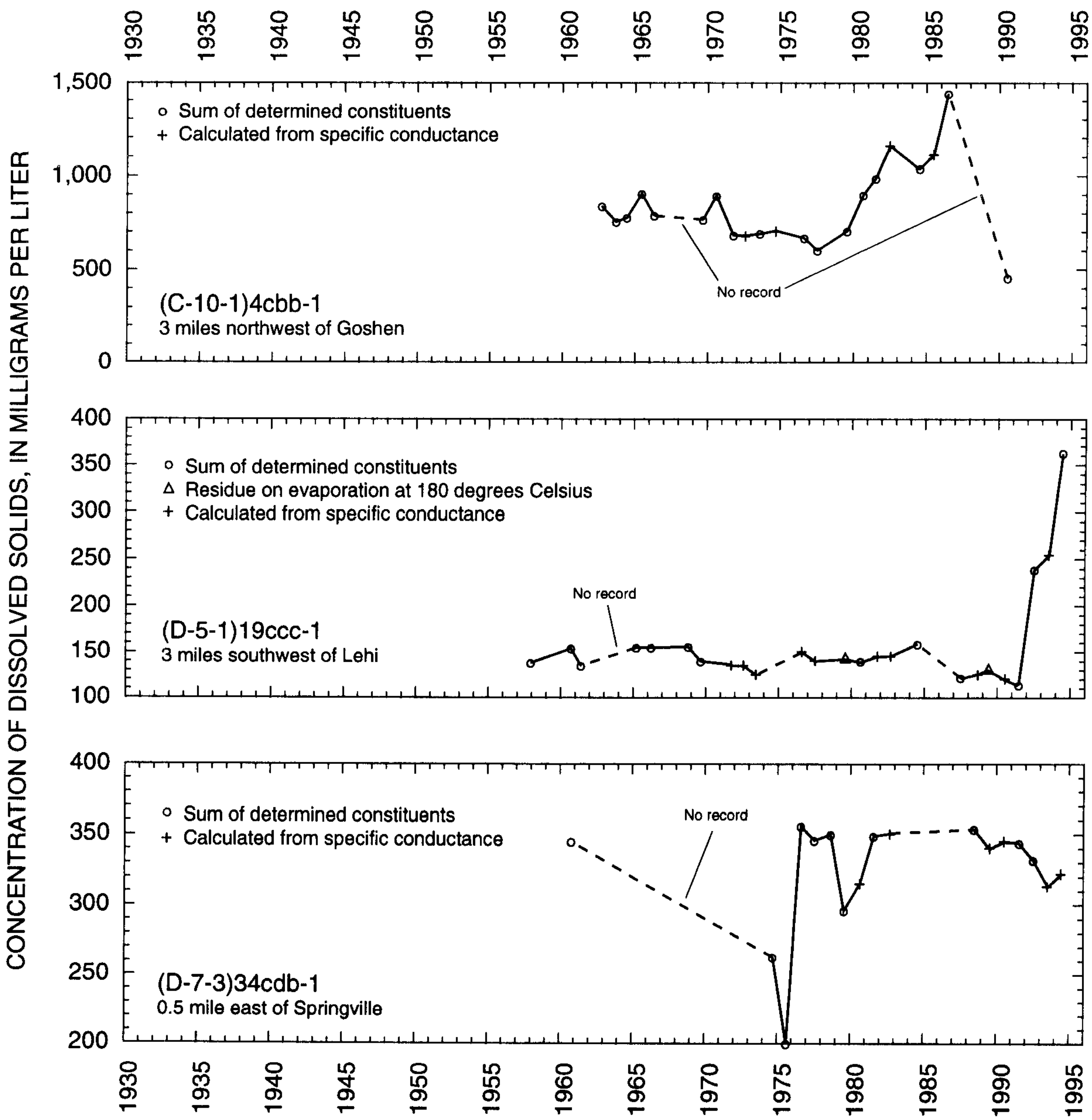



**Figure 15.** Relation of water levels in selected wells in Utah and Goshen Valleys to cumulative departure from the average annual precipitation at Timpanogos Cave and Spanish Fork Powerhouse, to total annual withdrawals from wells, to annual withdrawals for public supply, to annual discharge of Spanish Fork at Castilla, and to concentration of dissolved solids in water from selected wells—Continued.

## JUAB VALLEY

By J.I. Steiger

Withdrawal of water from pumped and flowing wells in Juab Valley in 1994 was about 26,000 acre-feet, which is 6,000 acre-feet more than was reported for 1993 and 6,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94, about 25,000 acre-feet, was 6,000 acre-feet more than for the preceding 5-year period, 1985-89, mainly because of increased withdrawals for irrigation. The increased withdrawals for irrigation resulted from less precipitation and surface water from March through September 1990-94 as compared with the same months during 1985-89.

Water levels declined throughout Juab Valley from March 1990 to March 1995. Declines of more than 5 feet were recorded in the irrigated area north of Mona; the largest decline, 21.7 feet, was measured north of Levan (fig. 16). The declines were related to increased withdrawals for irrigation and decreased recharge as a result of less precipitation and streamflow from March through September 1990-94, as compared with the preceding 5-year period, March through September, 1985-89.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1 is shown in figure 17. Precipitation at Nephi during 1994 was 17.25 inches, which is 2.90 inches more than the average annual precipitation for 1935-94. The 1990-94 average annual precipitation was 15.09 inches, which is 0.33 inch more than for the preceding 5-year period, 1985-89. The concentrations of dissolved solids in water from well (D-13-1)7dbc-1 fluctuated from 1964-94 with no apparent trend. The calculated concentration of dissolved solids for 1994 was slightly more than the measured concentration for 1993.

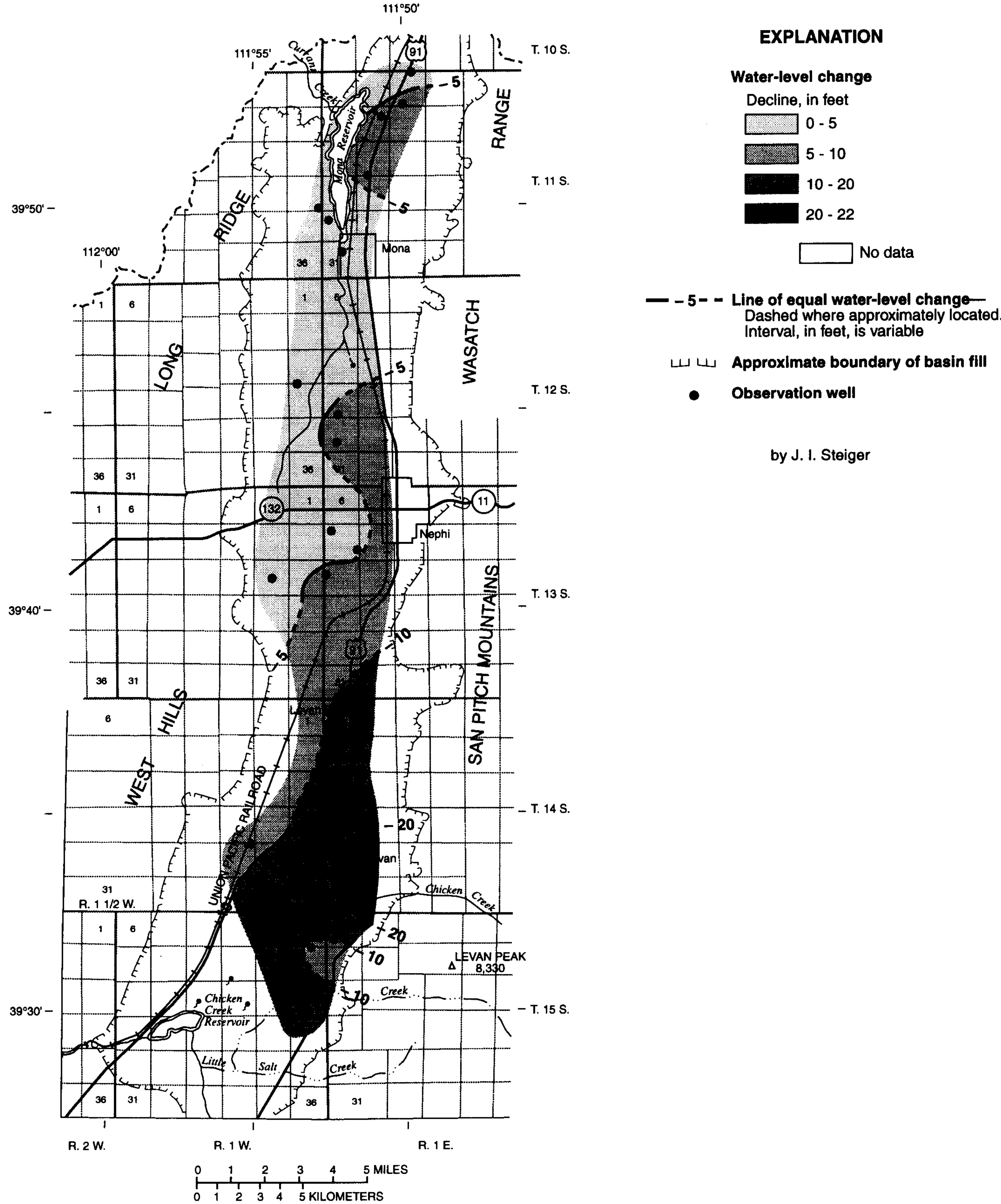



**Figure 16.** Map of Juab Valley showing change of water levels from March 1990 to March 1995.

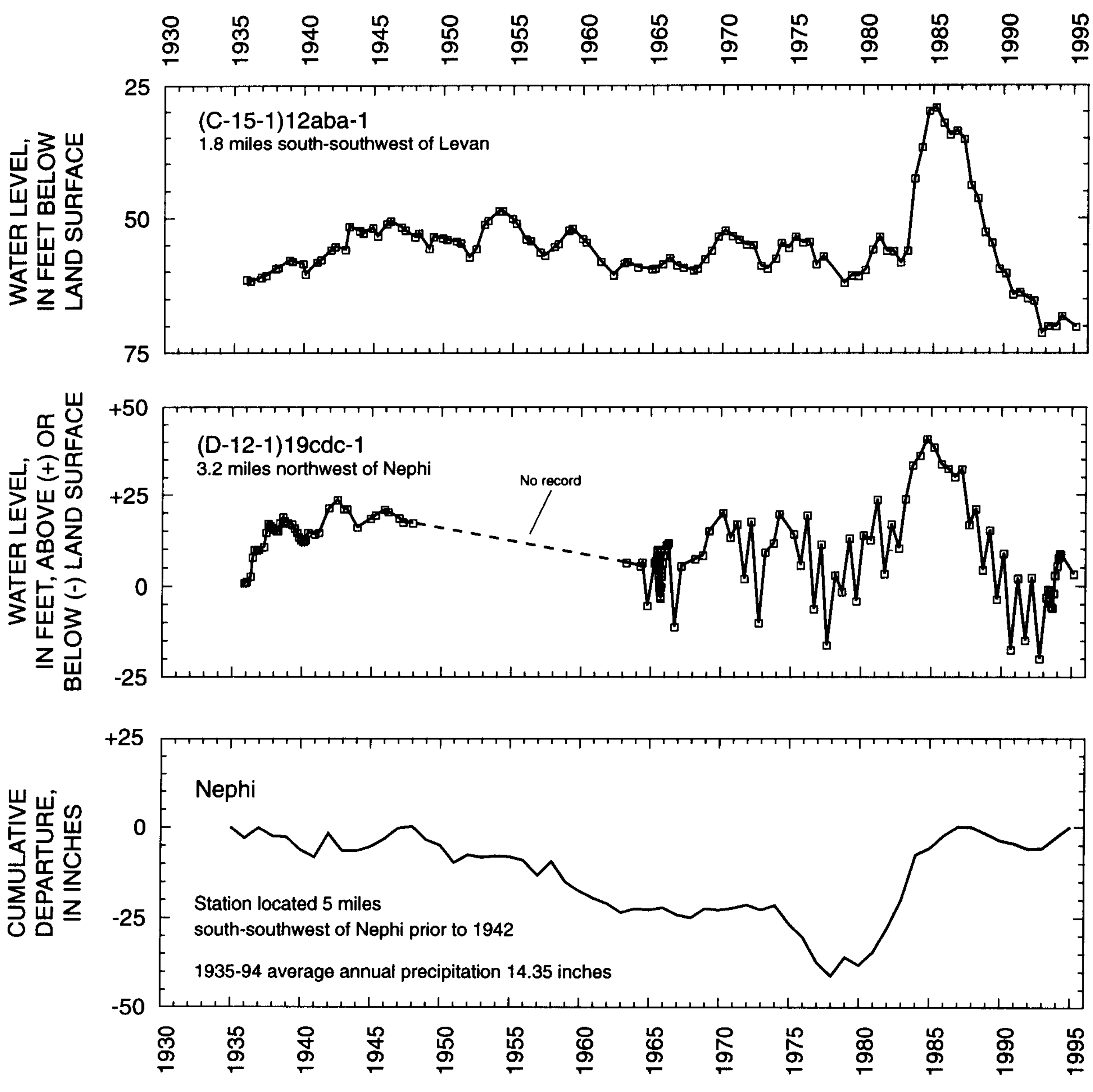



**Figure 17.** Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1.

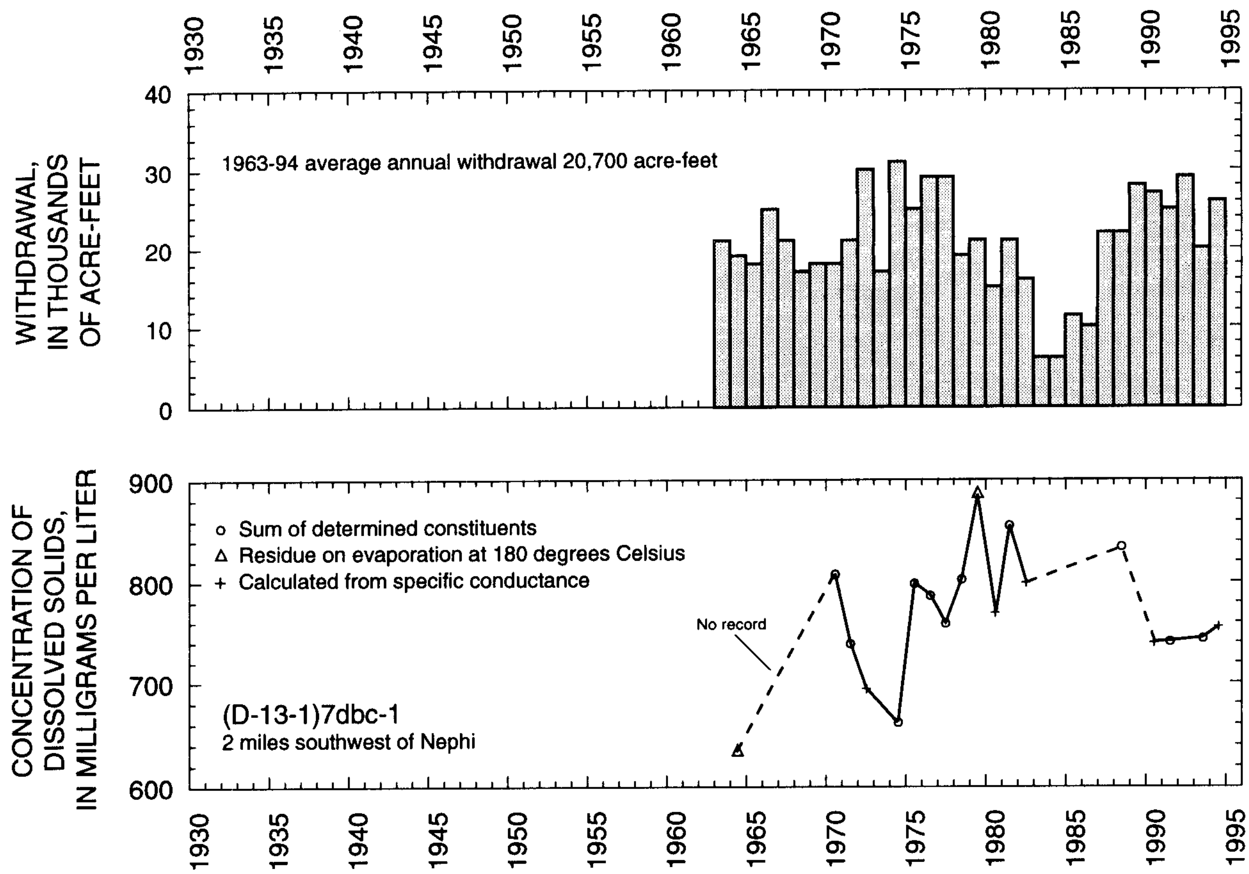



**Figure 17.** Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (D-13-1)7dbc-1—Continued.

## SEVIER DESERT

By S.J. Gerner

Withdrawal of water from wells in the Sevier Desert in 1994 was about 37,000 acre-feet, which is 6,000 acre-feet more than was reported for 1993 and about 16,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal during 1990-94 was about 34,000 acre-feet, which is 20,000 acre-feet more than for the preceding 5-year period, 1985-89.

Water levels in the shallow artesian aquifer declined from March 1990 to March 1995 (fig. 18). Large declines were found in an area south of Leamington and north of Oak City, with the largest decline, about 24 feet, observed near Oak City. The declines generally are smaller toward the north and west.

Water levels in the deep artesian aquifer declined from March 1990 to March 1995, with the largest decline, about 22.3 feet, measured in a well north of Oak City (fig. 19). Declines in water levels in both aquifers probably resulted from increased withdrawals during 1990-94, as compared with the preceding 5-year period, 1985-89.

The relation of water levels in selected wells to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1 is shown in figure 20.

Discharge of the Sevier River during 1994 was about 129,800 acre-feet, which is 2,600 acre-feet more than the discharge for 1993 and 51,600 acre-feet less than the long-term average (1935-94). Average annual discharge of the Sevier River during 1990-94 was about 118,900 acre-feet, which is about 181,800 acre-feet less than for the preceding 5-year period, 1985-89.

Precipitation at Oak City was 16.66 inches in 1994, which is 3.90 inches more than the average annual precipitation during 1935-94. Average annual precipitation for 1990-94 was 12.53 inches, which is 0.23 inch more than for the preceding 5-year period, 1985-89.

The concentration of dissolved solids in water from well (C-15-4)18daa-1, near Lynndyl, increased from about 900 milligrams per liter in 1958 to about 1,900 milligrams per liter in 1993. This increase probably resulted from recharge from water used for irrigation, which contains a higher concentration of dissolved solids than local ground water (Handy and others, 1969).

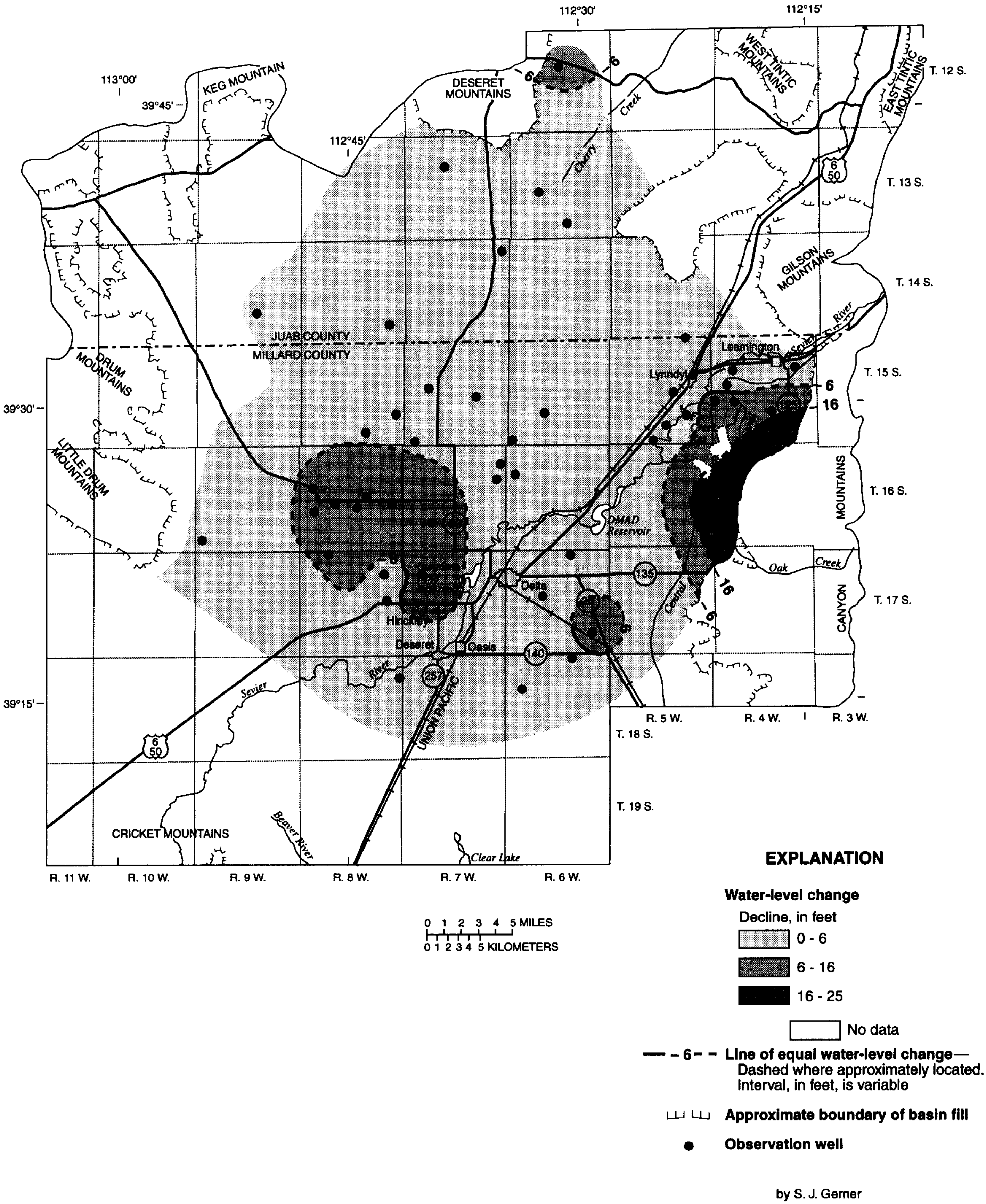



**Figure 18.** Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1990 to March 1995.

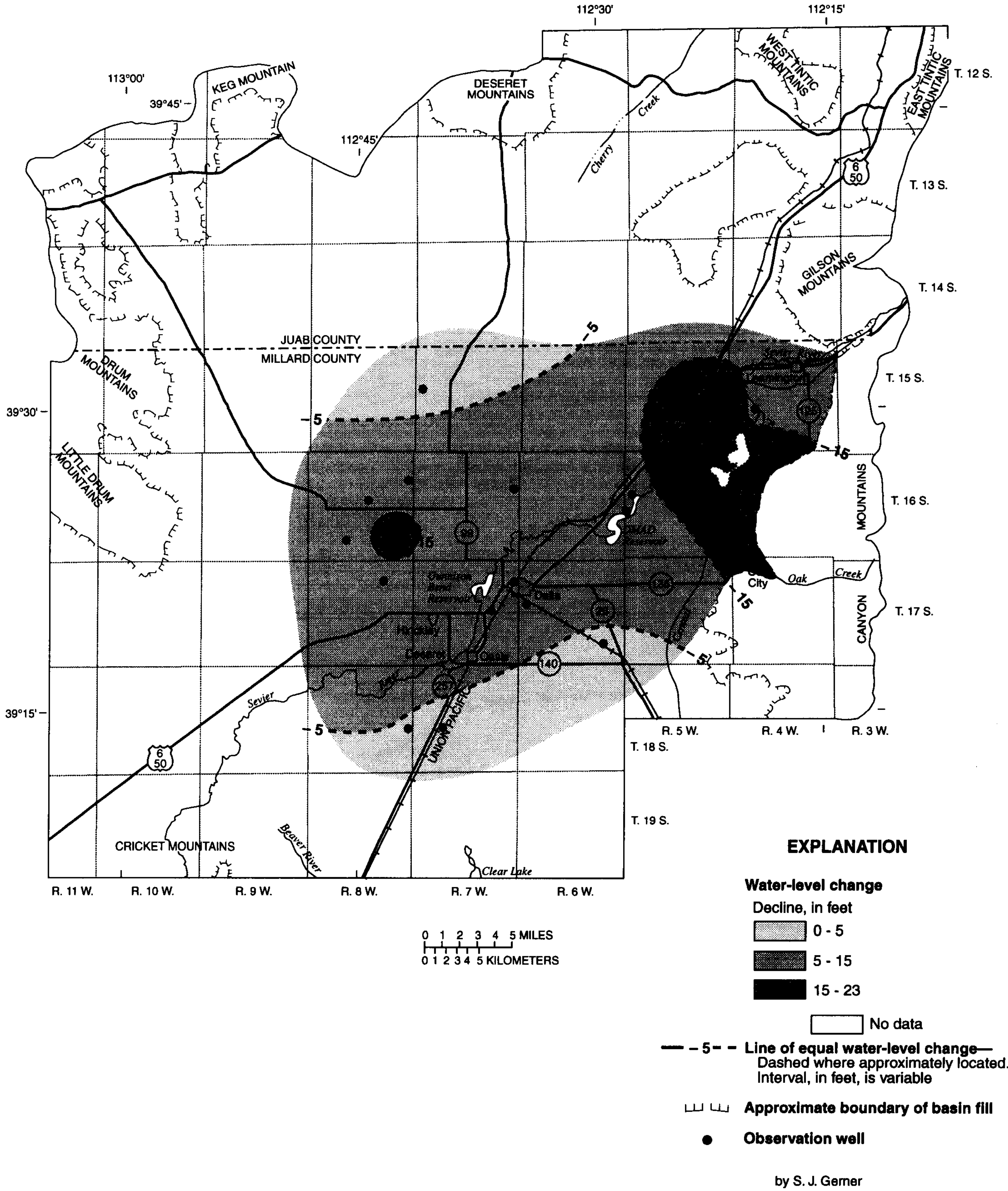



**Figure 19.** Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1990 to March 1995.

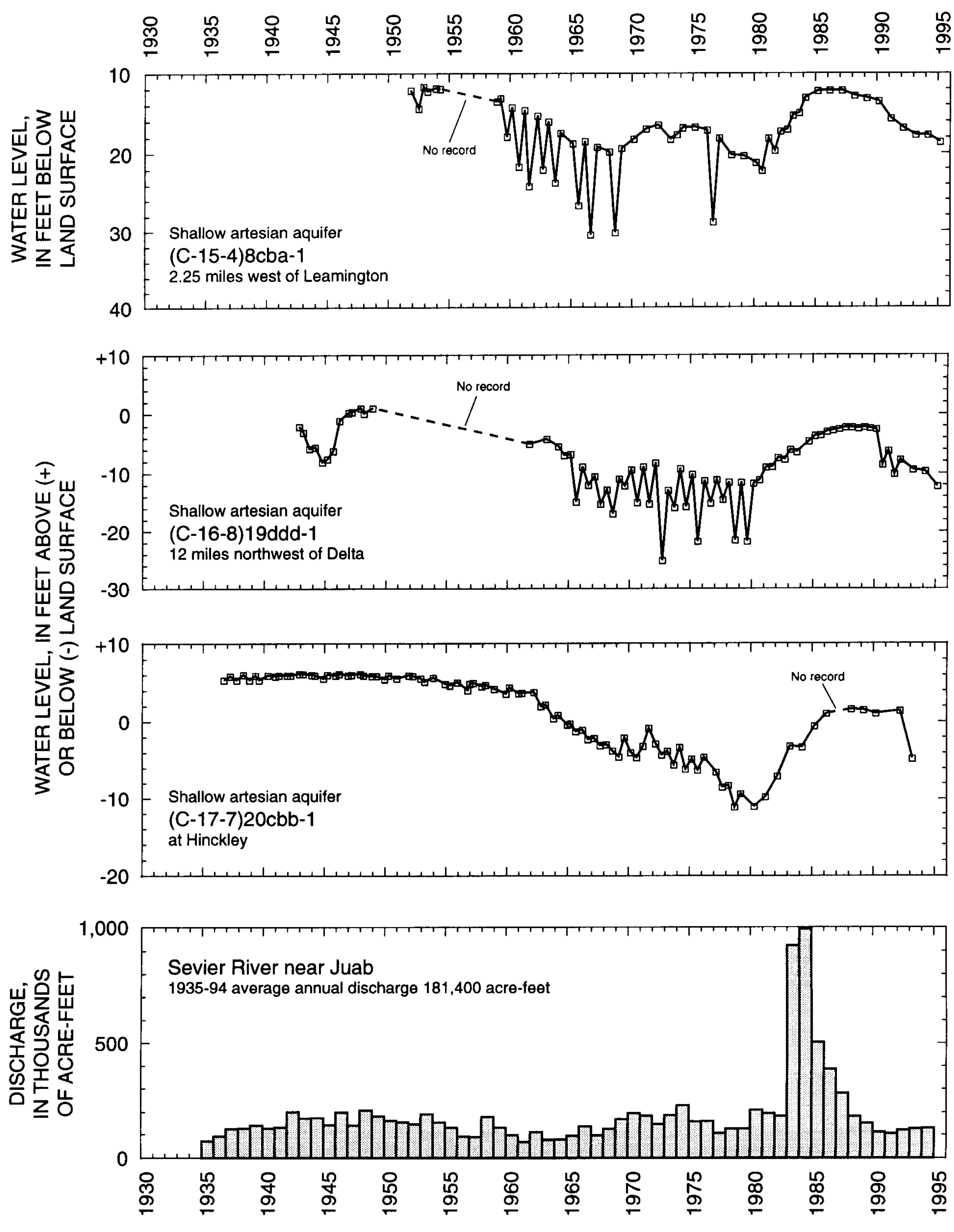



**Figure 20.** Relation of water levels in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1.

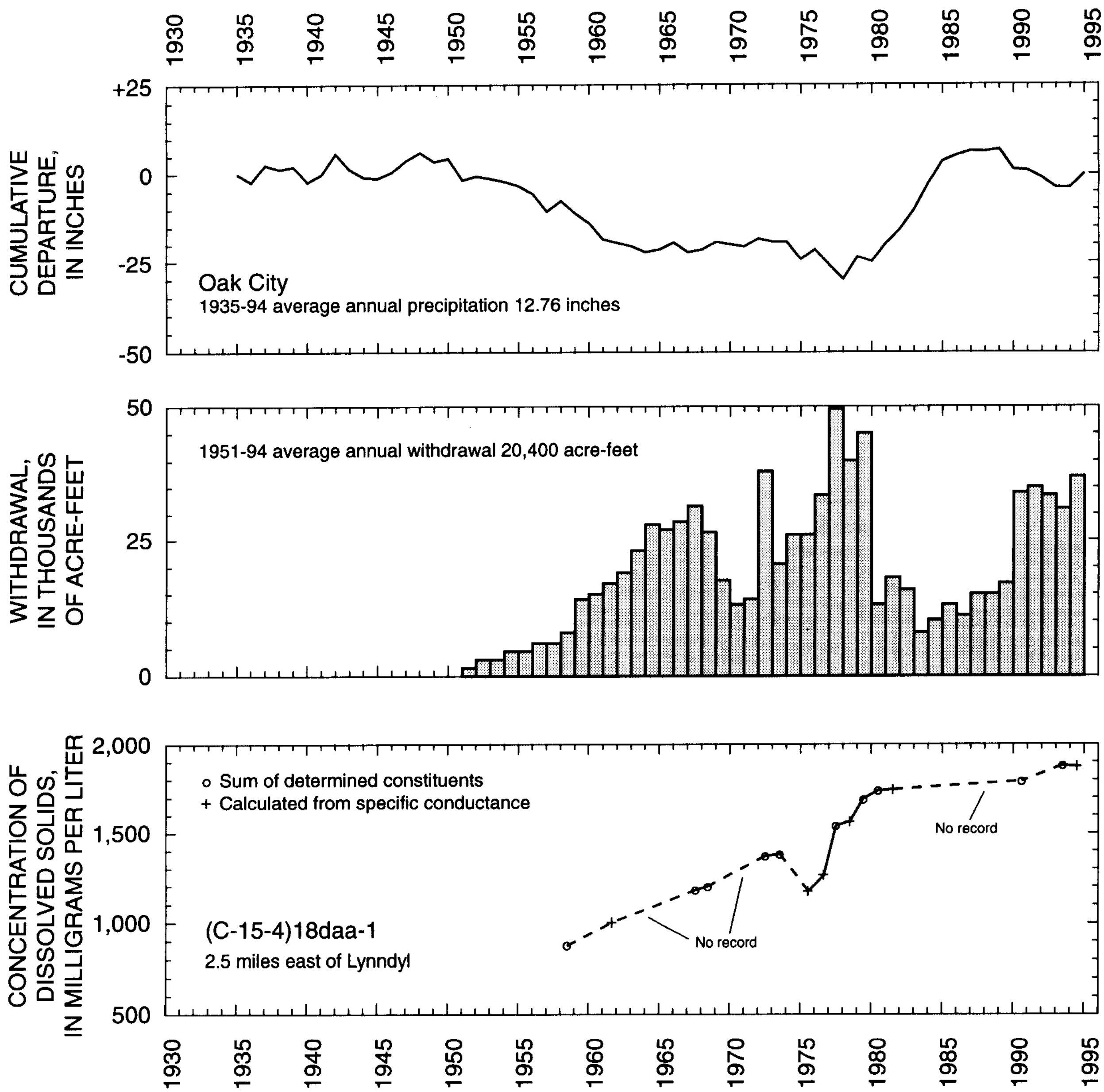



**Figure 20.** Relation of water levels in selected wells in the Sevier Desert to annual discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-15-4)18daa-1—Continued.

## CENTRAL SEVIER VALLEY

By B.A. Slaugh

Withdrawal of water from wells in central Sevier Valley in 1994 was about 20,000 acre-feet, which is 1,000 acre-feet more than was reported for 1993, 2,000 acre-feet more than the 10-year average annual withdrawal for 1984-93, 1,000 acre-feet more than for the 5-year average annual withdrawal for 1990-94, and 2,000 acre-feet more than for the 5-year average annual withdrawals for 1985-89 (tables 2 and 3).

Water levels generally declined in most of central Sevier Valley from March 1990 to March 1995 (fig. 21). The largest decline, about 4.5 feet, was measured in a well 2.0 miles southwest of Monroe. The decline in water levels probably is because of slightly less precipitation, resulting in less streamflow and less recharge during 1990-94 than during 1985-89, and because of greater withdrawals during 1990-94 than during 1985-89. Water levels rose slightly, less than 2 feet, in local areas west of Salina, east of Venice, north of Marysvale, and west of Kingston.

The relation of water levels in selected wells to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4 is shown in figure 22. Discharge of the Sevier River at Hatch in 1994 was about 58,400 acre-feet, which is 91,100 acre-feet less than the discharge of 149,500 acre-feet for 1993 and 20,400 acre-feet less than the 1940-94 average annual discharge. The average annual discharge during 1990-94 was about 68,000 acre-feet, which is 7,300 acre-feet less than during 1985-89.

Precipitation at Richfield was 7.60 inches in 1994, which is 0.71 inch less than the 1952-94 average annual precipitation. The average annual precipitation for 1990-94 was 8.14 inches, which is 0.07 inch less than for the preceding 5-year period, 1985-89. The concentration of dissolved solids in water from well (C-23-2)15dcb-4 has ranged from about 330 milligrams per liter to 630 milligrams per liter, with no apparent long-term trend.

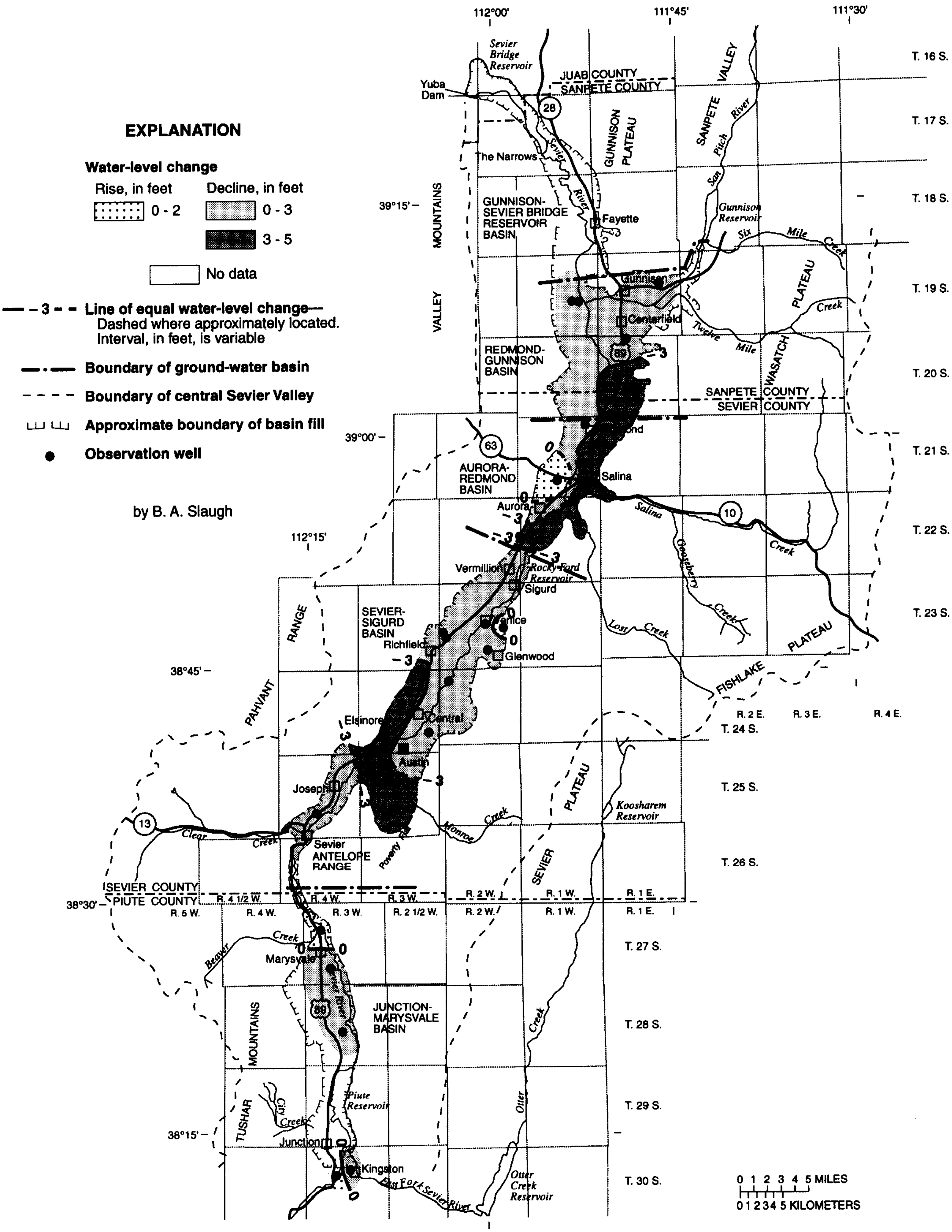


**Figure 21.** Map of central Sevier Valley showing change of water levels from March 1990 to March 1995.

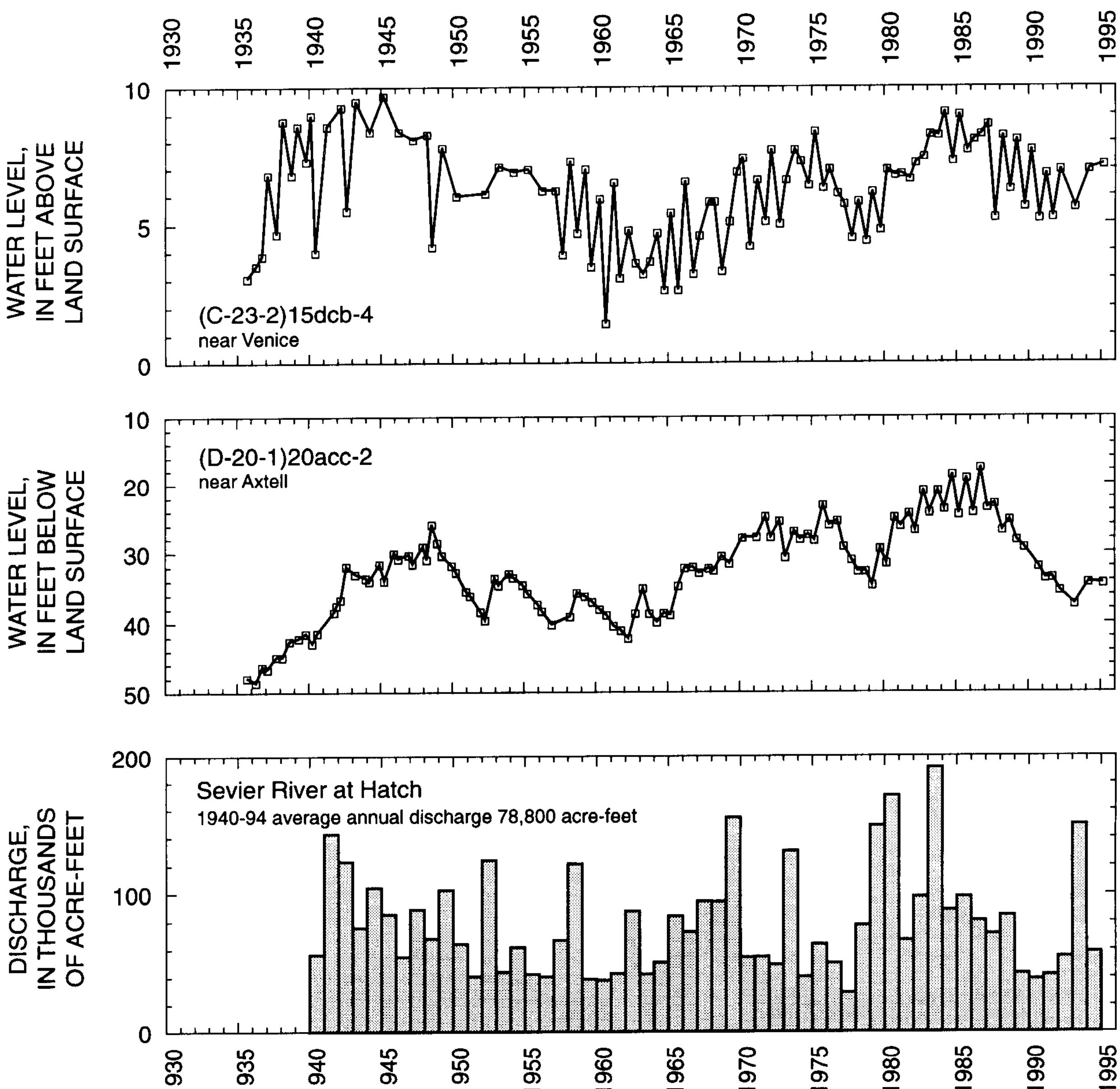



**Figure 22.** Relation of water levels in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4.

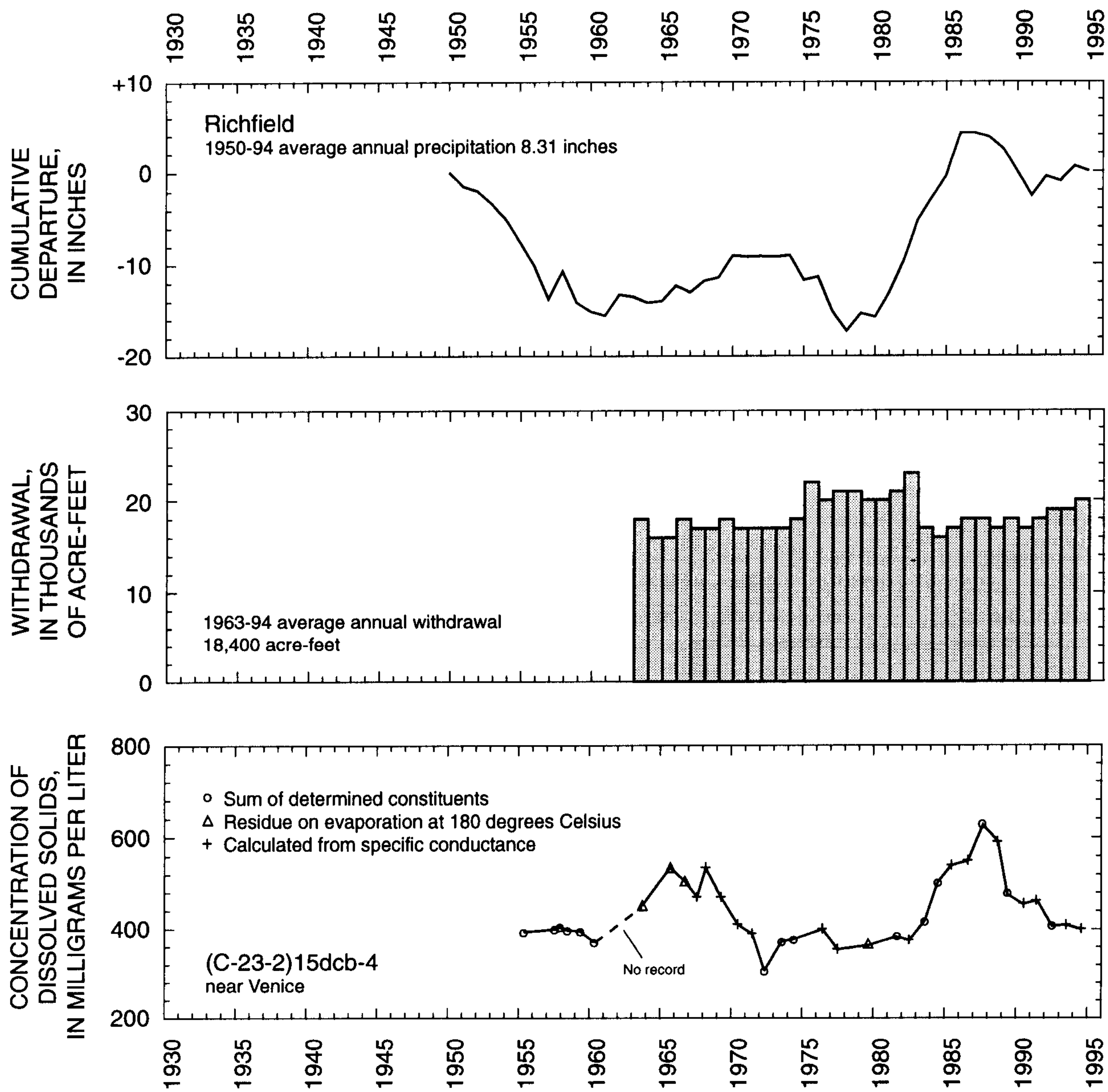



**Figure 22.** Relation of water levels in selected wells in central Sevier Valley to annual discharge of the Sevier River at Hatch, to cumulative departure from the average annual precipitation at Richfield, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-23-2)15dcb-4—Continued.

## PAHVANT VALLEY

### By R.L. Swenson

Withdrawal of water from wells in Pahvant Valley in 1994 was about 93,000 acre-feet, which is 6,000 acre-feet more than was reported for 1993, and 21,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). Withdrawals for irrigation increased substantially. Irrigation withdrawal for 1994 was almost 92,700 acre-feet, which is 6,300 acre-feet more than was reported for 1993. Withdrawals generally have increased during the last 10 years from an annual average of 68,000 acre-feet during 1985-89 to 86,000 acre-feet during 1990-94.

Water levels declined in most of Pahvant Valley from March 1990 to March 1995 (fig. 23). The maximum decline of almost 39 feet occurred just west of Holden. Declines of 20 feet or greater also occurred in areas along the eastern part of the valley just west of Fillmore, south of Meadow and northeast of Hatton, and in a small area in the southernmost part of the valley. Declines in water levels probably resulted from substantially increased withdrawals for irrigation. Water-level rises were measured in local areas along the northeastern edge of the valley. A rise of almost 13 feet was measured in a shallow well in Holden.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells is shown in figure 24. Precipitation at Fillmore during 1994 was 18.50 inches, which is 3.52 inches more than the average annual precipitation for 1931-94. The average annual precipitation during 1990-94 was 15.86 inches which is 1.07 inches more than during the preceding 5-year period, 1985-89.

The concentration of dissolved solids in water from wells near Flowell and west of Kanosh is shown in figure 25. The sample from (C-21-5)7cdd-3, northwest of Flowell, showed a slight increase in dissolved solids for 1994. The well west of Kanosh, (C-23-6) 21bdd-1, was not sampled in 1994. Water from both wells shows a general increase in concentration since the mid-1950s.

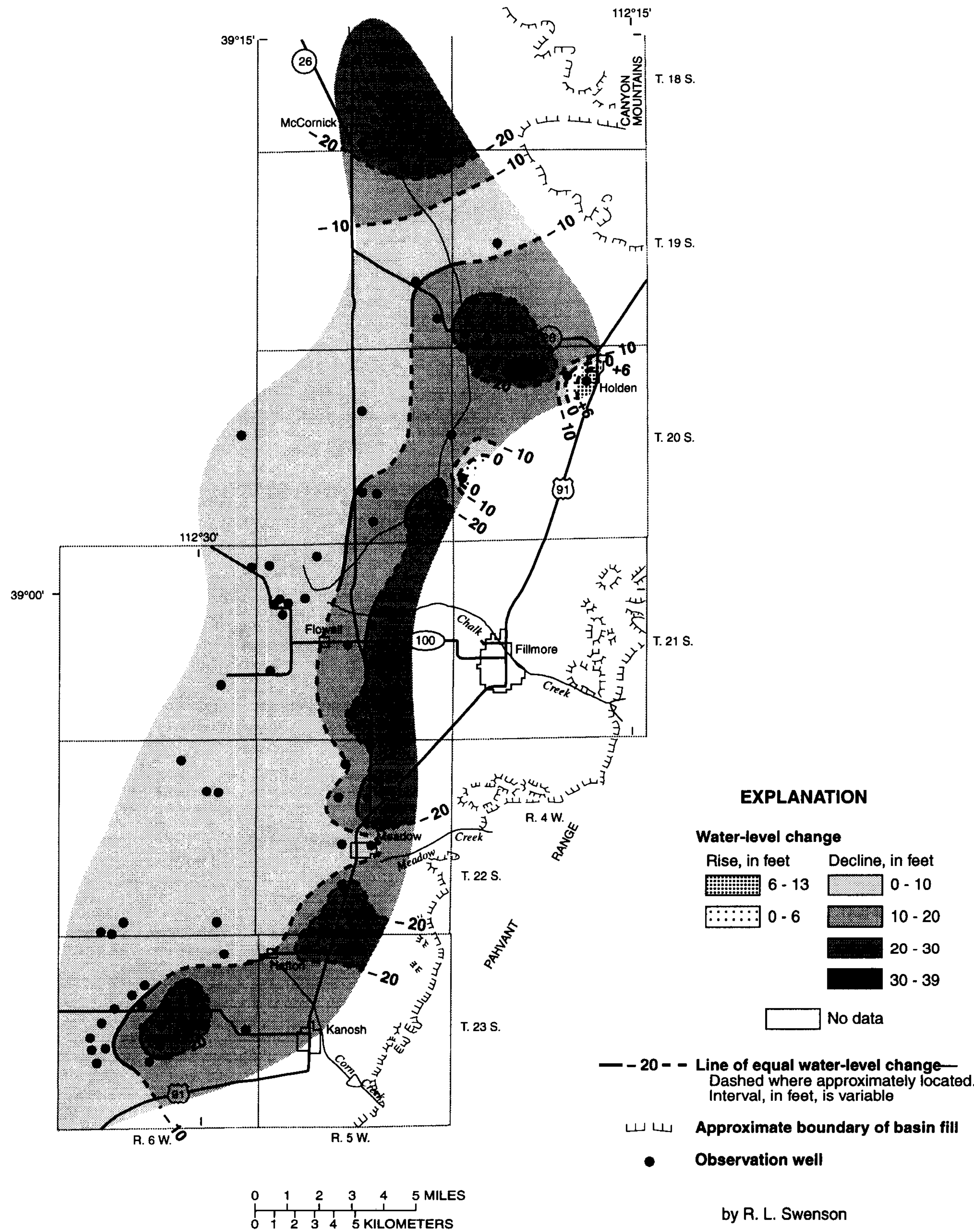



**Figure 23.** Map of Pahvant Valley showing change of water levels from March 1990 to March 1995.

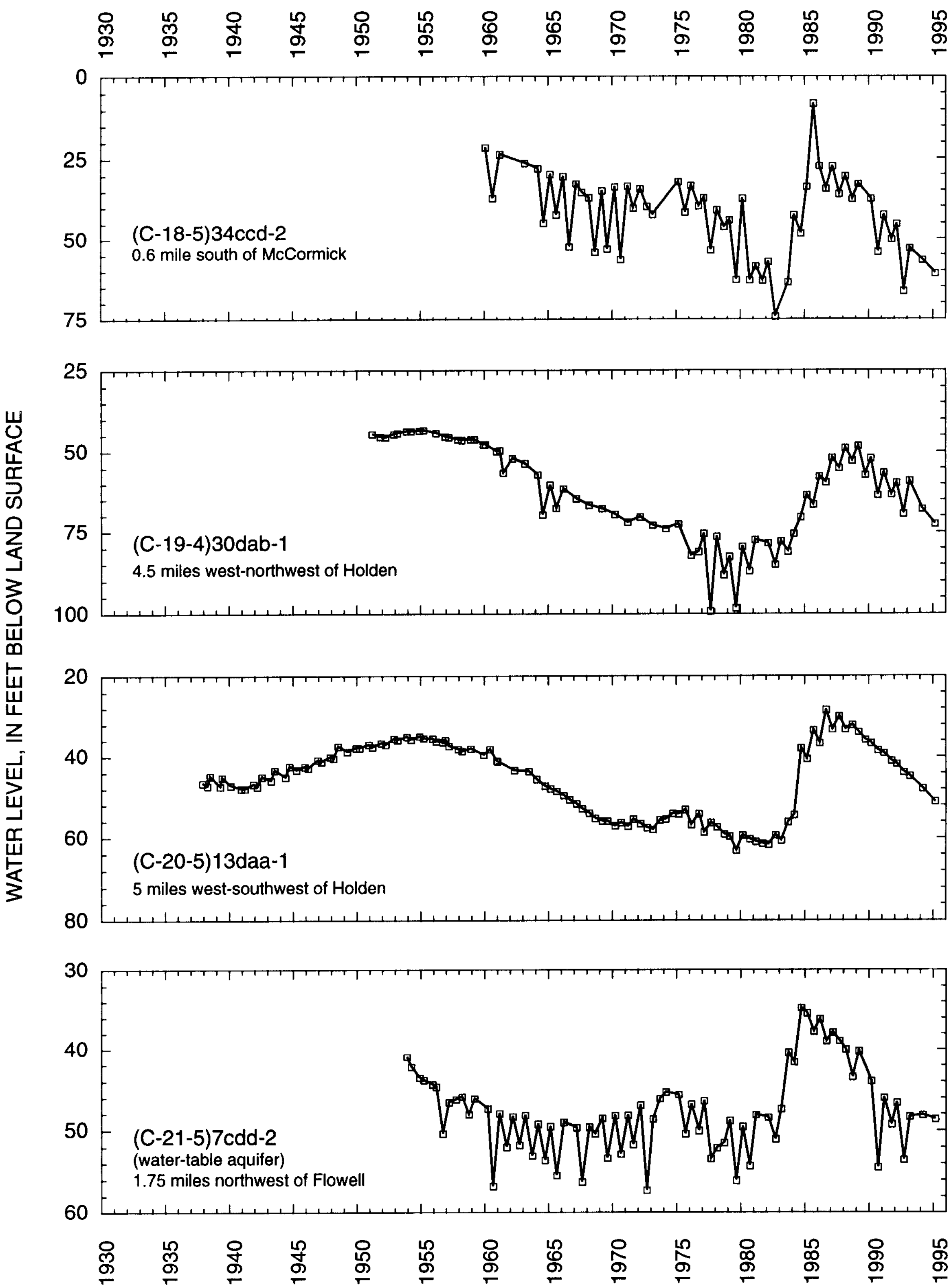



**Figure 24.** Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells.

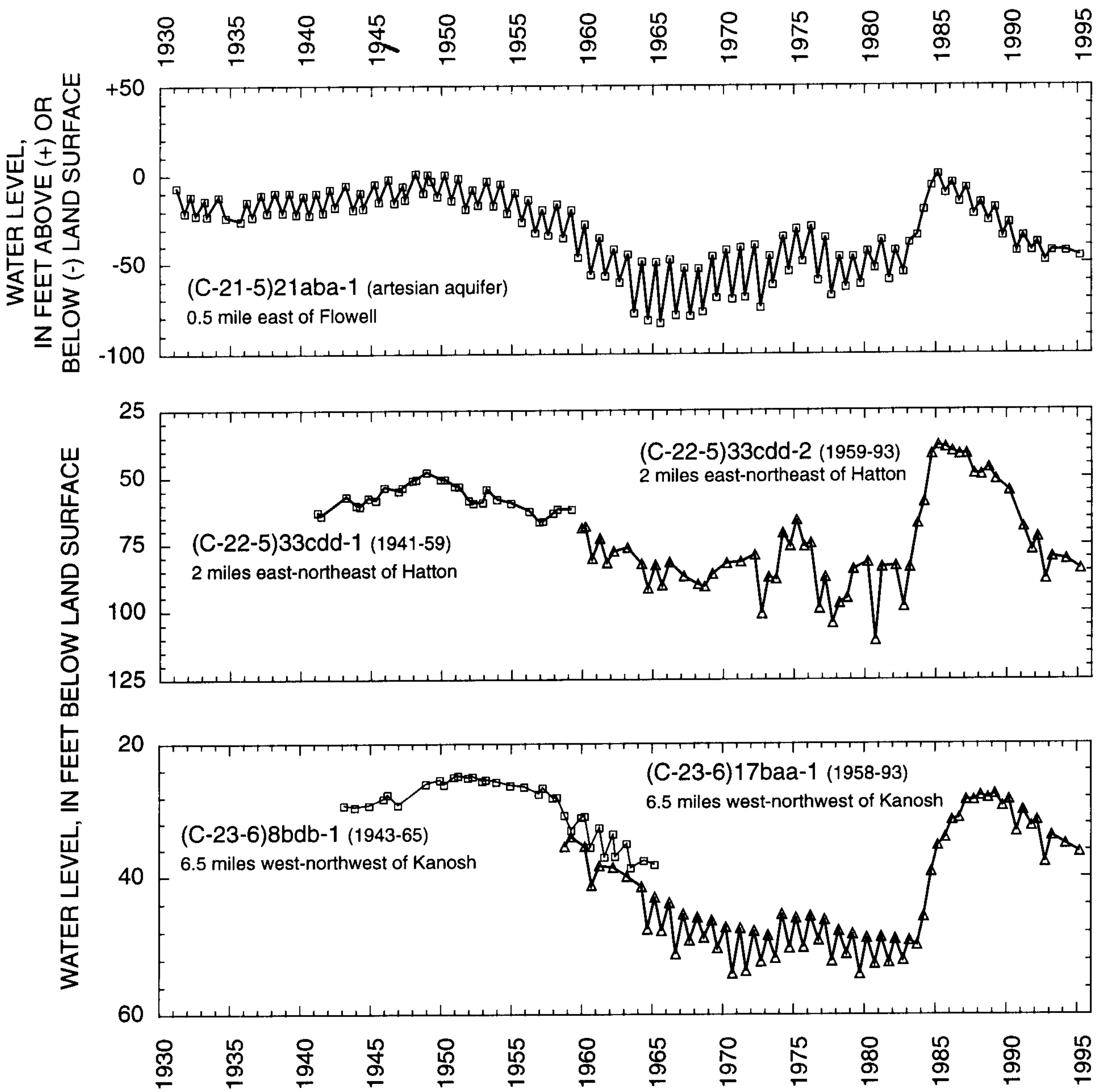



**Figure 24.** Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

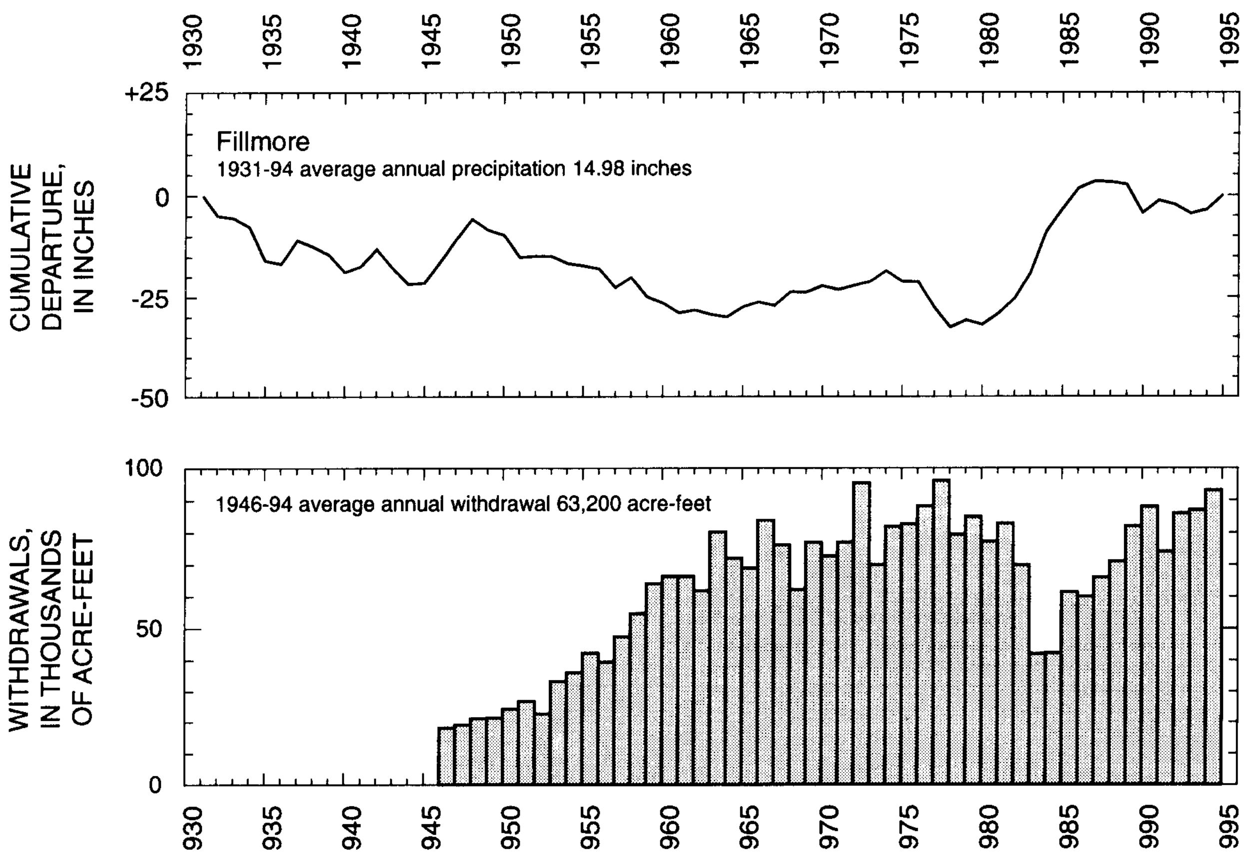



**Figure 24.** Relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells—Continued.

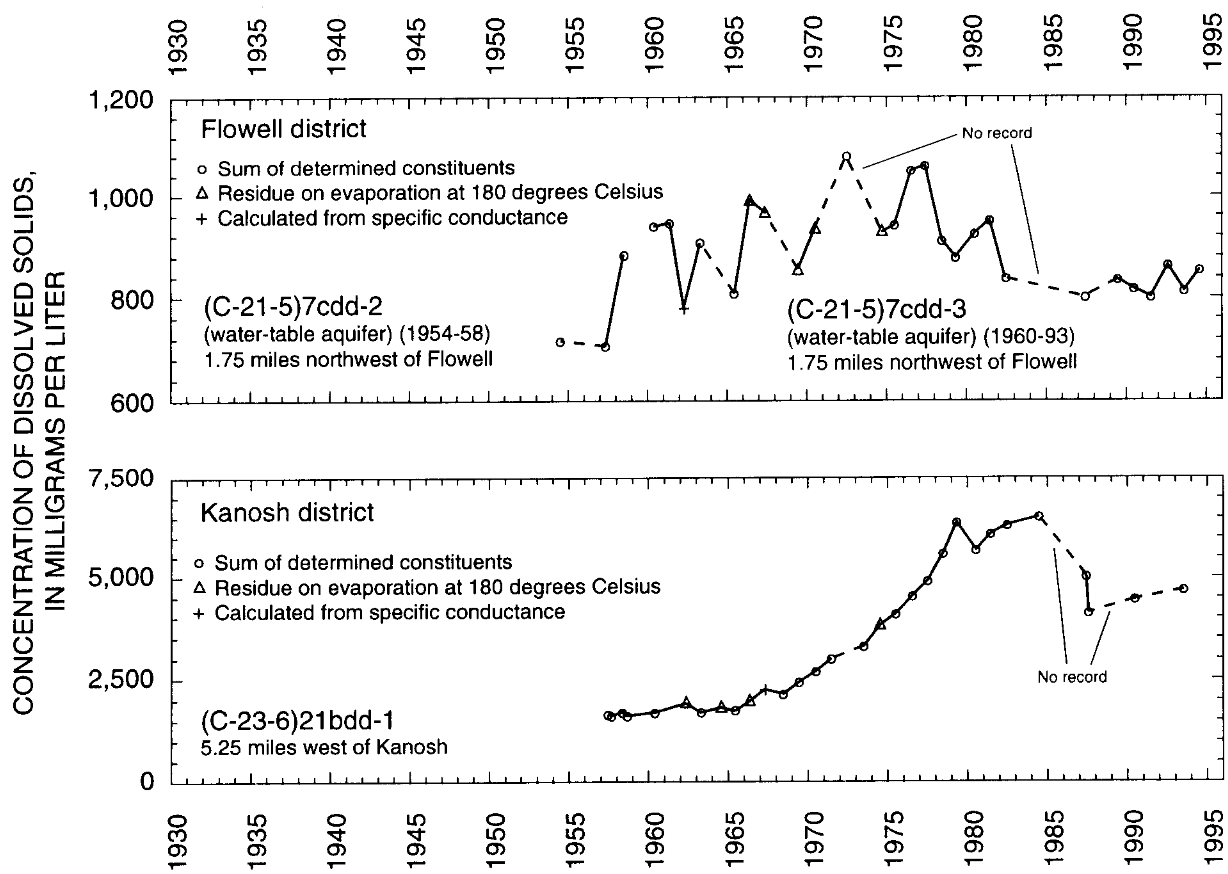



**Figure 25.** Concentration of dissolved solids in water from selected wells in Pahvant Valley.

## CEDAR VALLEY, IRON COUNTY

By J.H. Howells

Withdrawal of water from wells in Cedar Valley, Iron County, in 1994 was about 34,000 acre-feet, which is 1,000 acre-feet more than was reported for 1993 and 8,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). Average annual withdrawal during 1990-94 was about 33,000 acre-feet, which is 11,000 acre-feet more than during the preceding 5-year period, 1985-89.

Ground-water levels declined from March 1990 to March 1995 in all of Cedar Valley except near Kanarraville (fig. 26). The largest declines, of almost 17 feet, occurred in wells northwest of Cedar City. The declines probably resulted from increased withdrawals for irrigation and decreased recharge because of less precipitation and streamflow during 1990-94 as compared with the preceding 5-year period, 1985-89. Discharge of Coal Creek during 1990-94 was about 96 percent of the discharge during 1985-89.

The relation of water levels in wells (C-35-11) 33aac-1 and (C-37-12)34abb-1 to cumulative departure from the average annual precipitation at Cedar City Federal Aviation Administration (FAA) Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals of water from wells in Cedar Valley, and to concentration of dissolved solids in water from selected wells, is shown in figure 27. Precipitation at Cedar City FAA Airport in 1994 was 10.88 inches, which is 0.58 inch less than for 1993 and 0.11 inch more than the average annual precipitation for 1951-94. Average annual precipitation for 1990-94 was 10.92 inches, which is 0.33 inch less than during the preceding 5-year period, 1985-89.

Discharge of Coal Creek was about 16,700 acre-feet in 1994, which is 33,200 acre-feet less than the revised value for 1993, and 7,200 acre-feet less than the average annual discharge during 1939-94. The average annual discharge of Coal Creek during 1990-94 was about 22,200 acre-feet, which is 800 acre-feet less than for the previous 5-year period, 1985-89. The concentration of dissolved solids in water from well (C-37-12) 23acb-2 increased slightly since 1993.

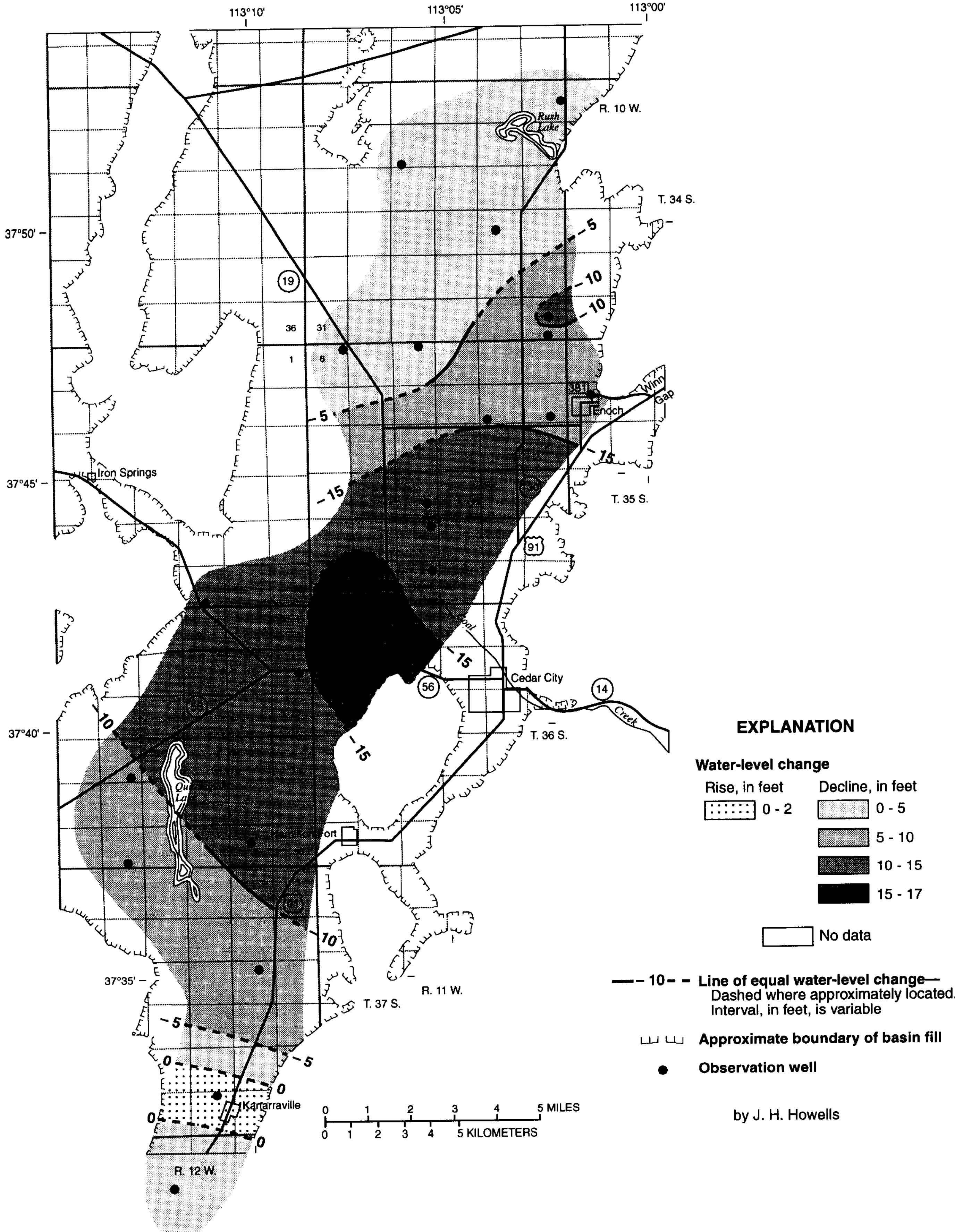



**Figure 26.** Map of Cedar Valley, Iron County, showing change of water levels from March 1990 to March 1995.

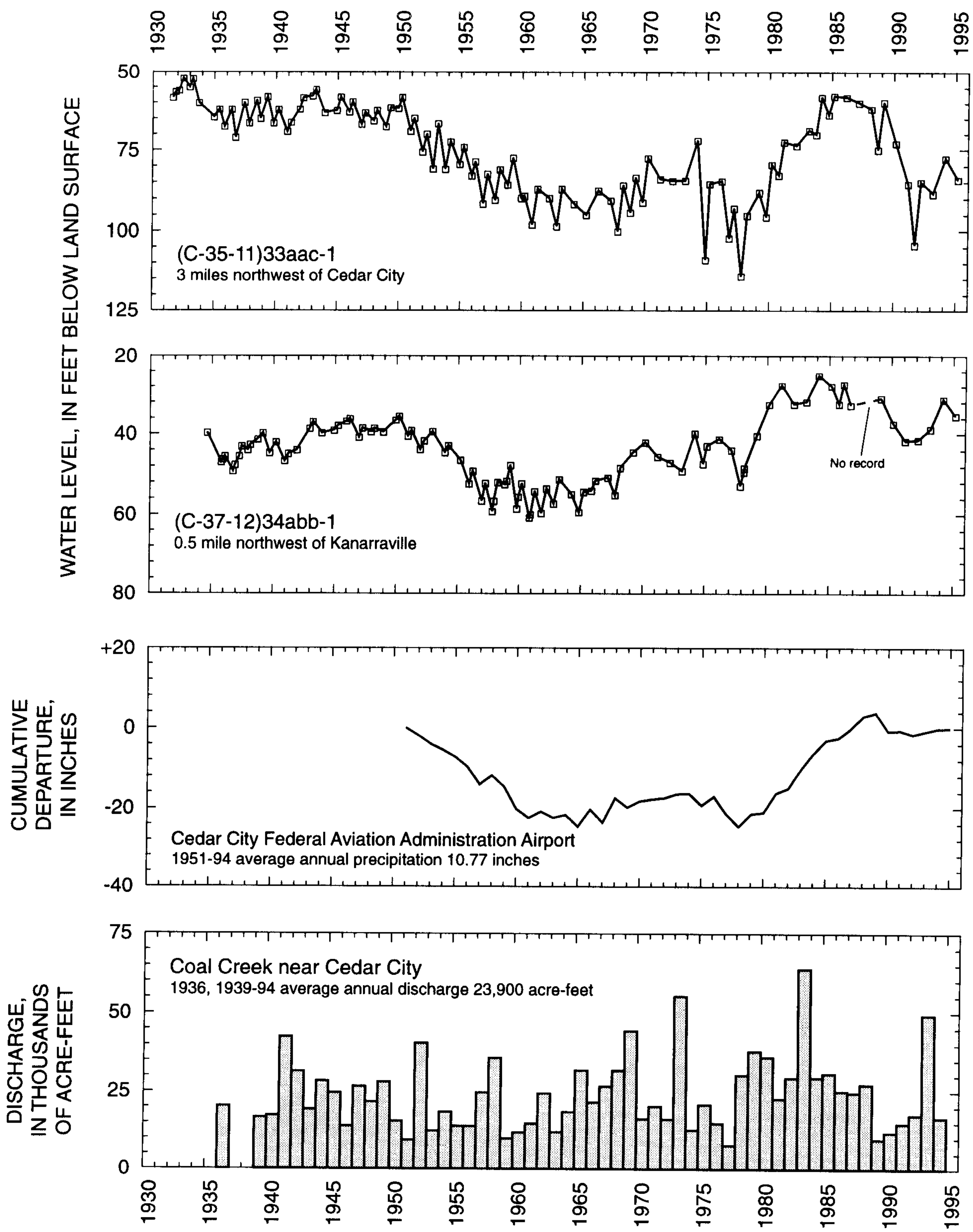



**Figure 27.** Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at Cedar City FAA Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells.

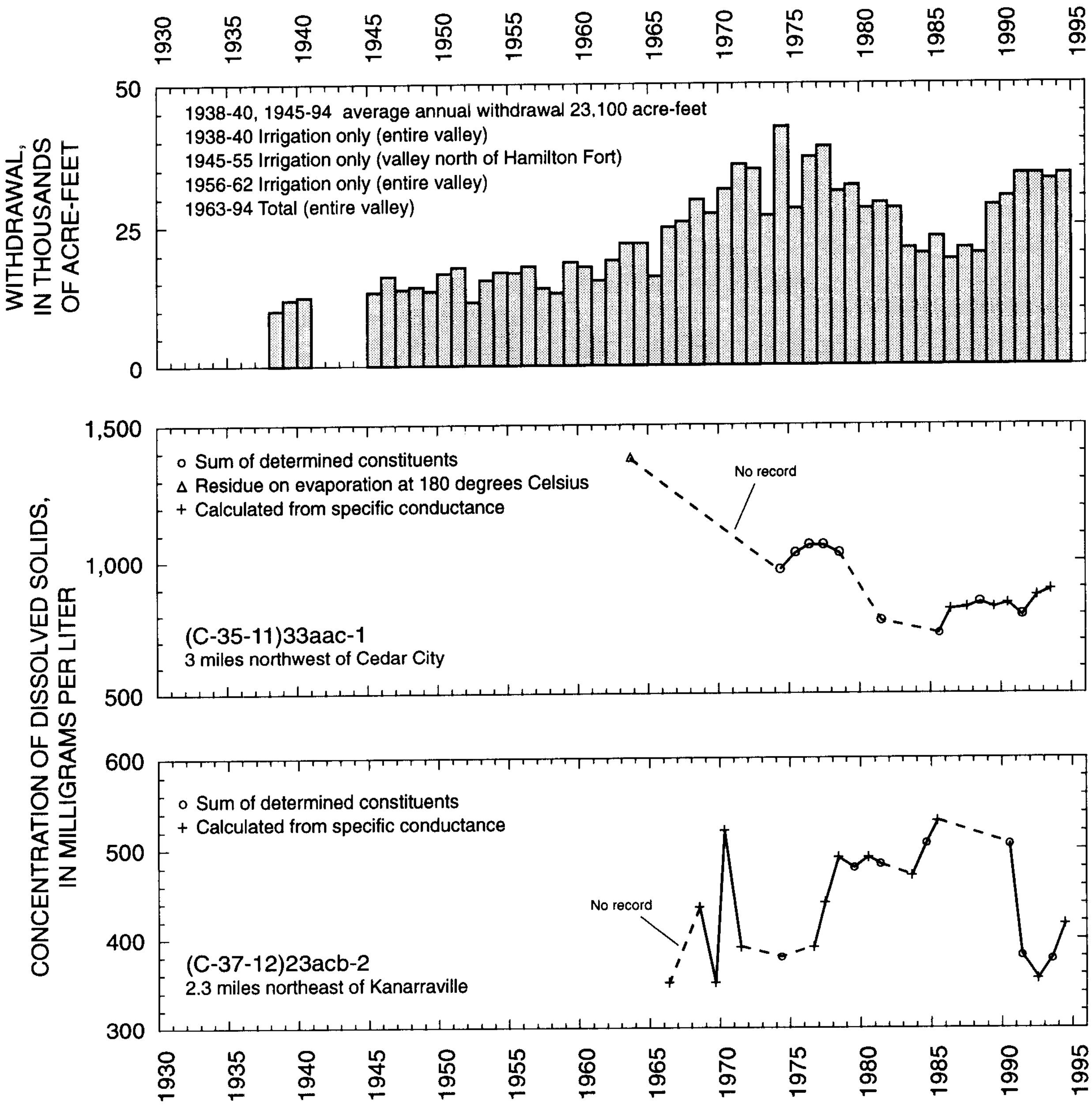



**Figure 27.** Relation of water levels in selected wells in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at Cedar City FAA Airport, to annual discharge of Coal Creek near Cedar City, to annual withdrawals from wells, and to concentration of dissolved solids in water from selected wells—Continued.

## PAROWAN VALLEY

### By J.H. Howells

Withdrawal of water from wells in Parowan Valley in 1994 was about 30,000 acre-feet, which is about 2,000 acre-feet more than was reported for 1993 and 4,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was about 30,000 acre-feet, which is 6,000 acre-feet more than for the preceding 5-year period, 1985-89.

Water levels declined from March 1990 to March 1995 in all parts of Parowan Valley for which data are available, except for an area about 10 miles north and east of Paragonah, where water levels rose slightly (fig. 28). The largest declines, from about 32 to 48 feet, occurred in an area northwest of Parowan and west of Paragonah. The decline in water levels probably resulted from continuing greater-than-average withdrawals for irrigation.

The relation of water levels in wells (C-34-8)5bca-1 and (C-34-10)24cbc-2 to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawal from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1 is shown in figure 29. Precipitation at Parowan Power Plant in 1994 was 14.48 inches, which is 2.06 inches more than for 1935-94. The average annual precipitation for 1990-94 at Parowan Power Plant was 13.14 inches, which is 0.18 inch more than for the preceding 5-year period, 1985-89. The concentration of dissolved solids in water from well (C-33-8)31ccc-1 has shown little change since 1976.

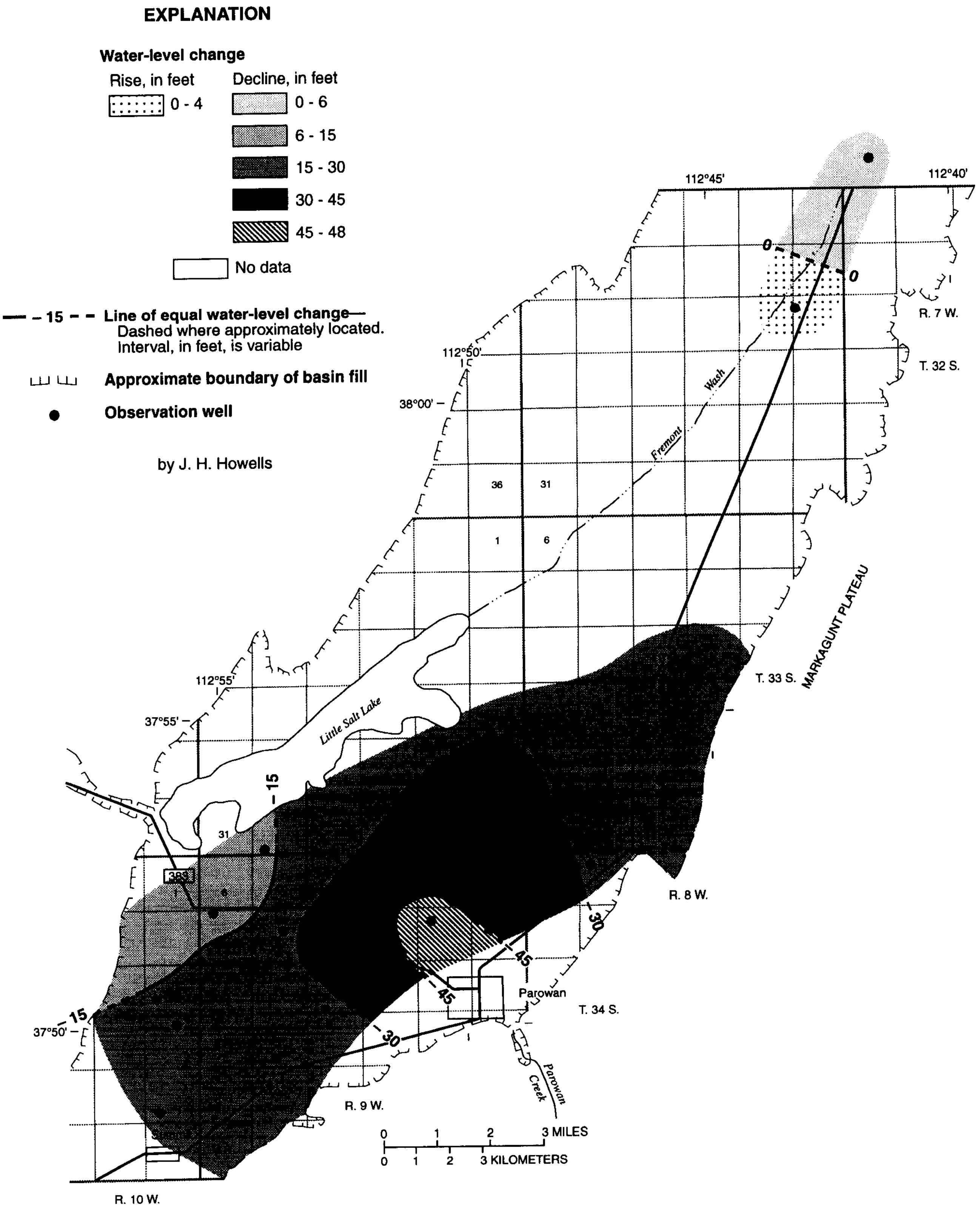



**Figure 28.** Map of Parowan Valley showing change of water levels from March 1990 to March 1995.

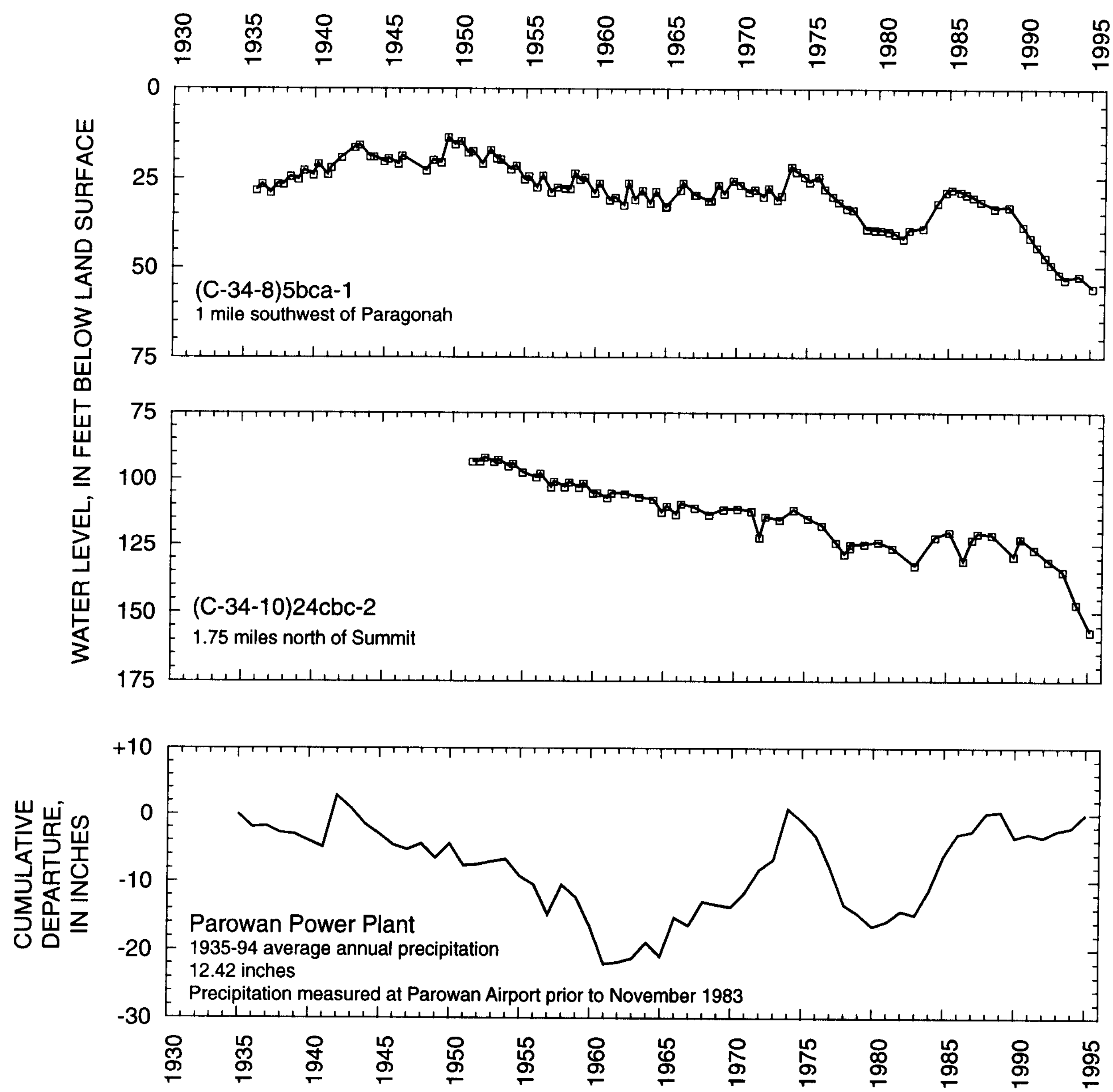



**Figure 29.** Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1.

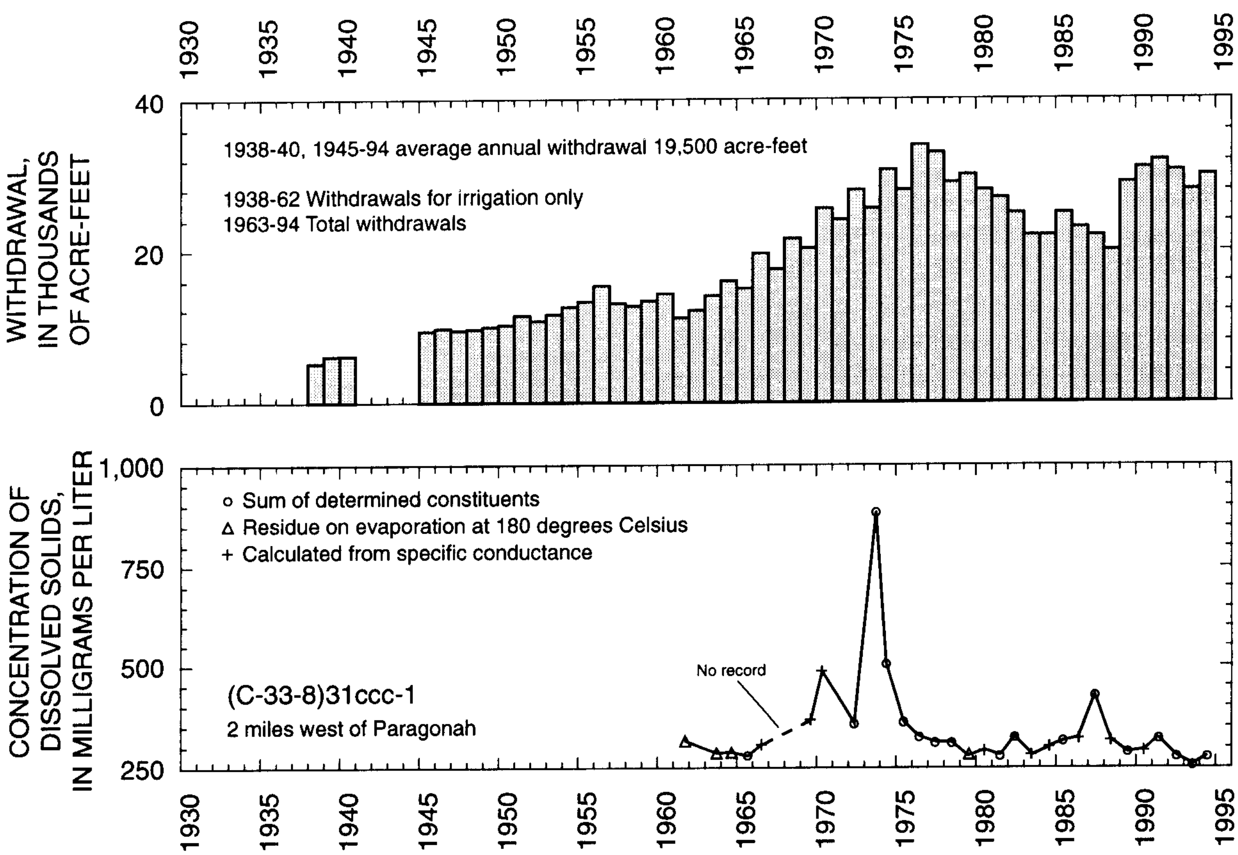



**Figure 29.** Relation of water levels in selected wells in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-33-8)31ccc-1—Continued.

# ESCALANTE VALLEY

## Milford Area

By B.A. Slaugh

Withdrawal of water from wells in the Milford area of the Escalante Valley in 1994 was about 61,000 acre-feet, which is 11,000 acre-feet more than was reported for 1993 and 16,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was about 51,000 acre-feet, which is 6,000 acre-feet more than for the preceding 5-year period, 1985-89. Withdrawals increased each year from 1988 to 1991, decreased in 1992, and increased again in 1993-94.

Water levels declined in most of the Milford area from March 1990 to March 1995 with the greatest decline, about 17 feet, measured in a well 6 miles south-southeast of Milford (fig. 30). Declines in water levels probably resulted from increased withdrawals of water from wells during 1990-94 and decreased recharge because of less streamflow in the Beaver River during 1990-94 as compared with the preceding 5-year period, 1985-89. Water levels rose about 3 feet in the northeastern part of the valley.

The relation of water levels in selected wells to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1, is shown in figure 31. Precipitation at Black Rock in 1994 was 11.90 inches, which is 1.88 inches more than reported for 1993 and 2.88 inches more than the 1952-94 average annual precipitation. The average annual precipitation at Black Rock during 1990-94 was 10.13 inches, which is 0.99 inch more than during 1985-89.

Discharge of the Beaver River in 1994 was about 20,600 acre-feet, which is 6,700 acre-feet less than the 1993 discharge and 8,500 acre-feet less than the 1931-94 average annual discharge. The average annual discharge for 1990-94 was about 17,900 acre-feet, which is 19,500 acre-feet less than during 1985-89. The concentration of dissolved solids in water from well (C-28-11)25dcd-1 increased from less than 600 milligrams per liter in the 1950s to about 1,700 milligrams per liter in 1986 and decreased to about 1,200 milligrams per liter in 1994.

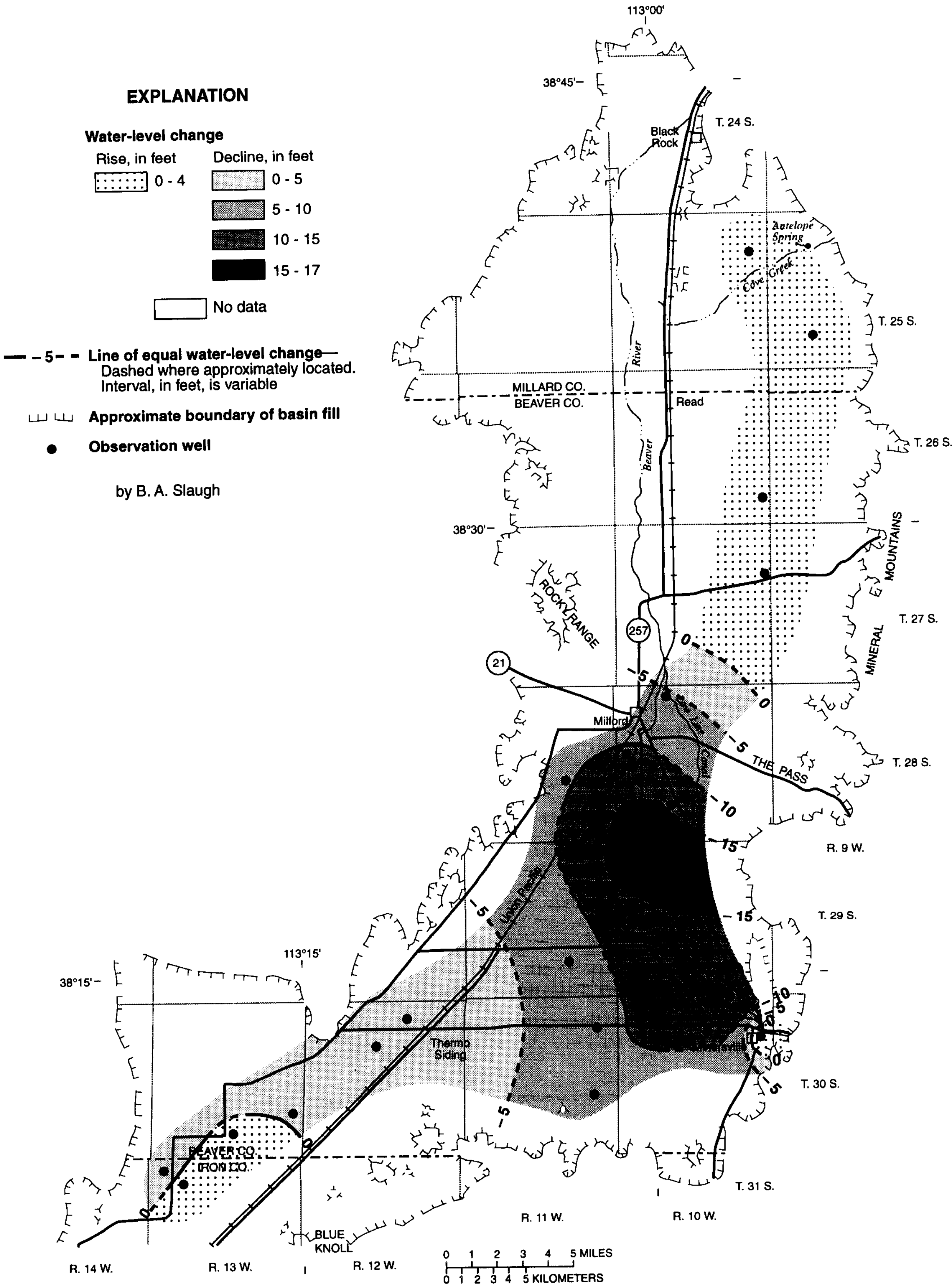



**Figure 30.** Map of the Milford area showing change of water levels from March 1990 to March 1995.

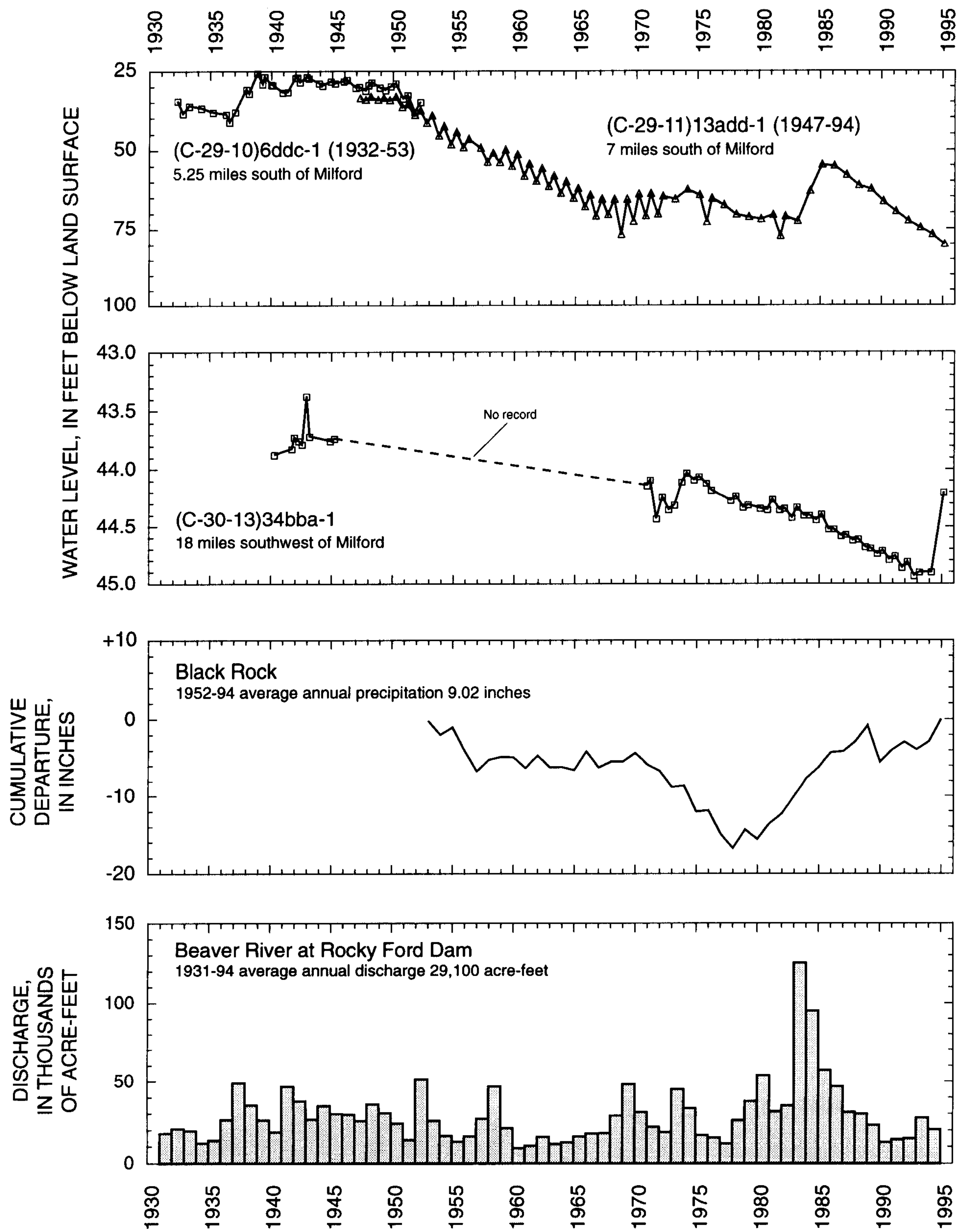



**Figure 31.** Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1.

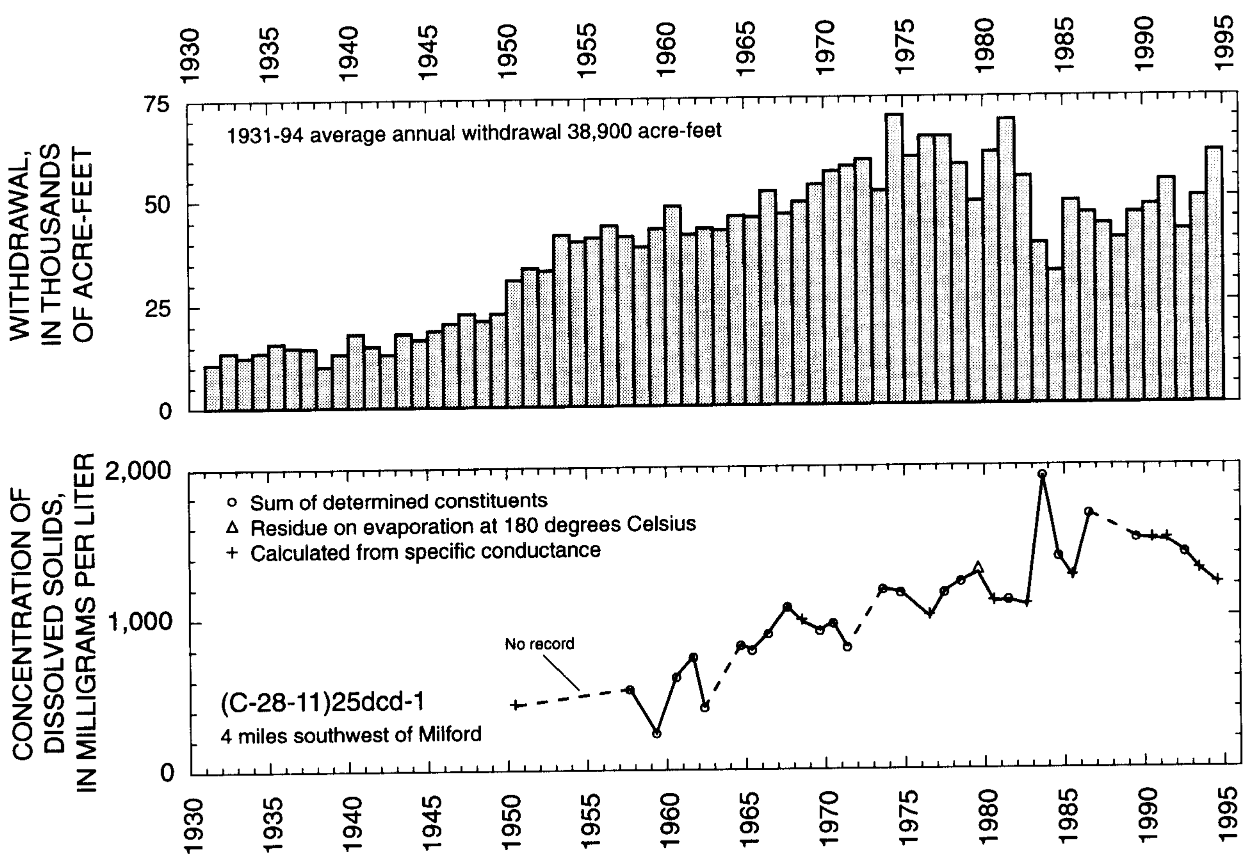



**Figure 31.** Relation of water levels in selected wells in the Milford area to cumulative departure from the average annual precipitation at Black Rock, to annual discharge of the Beaver River at Rocky Ford Dam, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-28-11)25dcd-1—Continued.

# ESCALANTE VALLEY

## Beryl-Enterprise Area

By H.K. Christiansen

Withdrawal of water from wells in the Beryl-Enterprise area in 1994 was about 86,000 acre-feet, which is 8,000 acre-feet more than in 1993, and 1,000 acre-feet less than the average annual withdrawal for 1984-93 (tables 2 and 3). The average annual withdrawal for 1990-94 was about 80,000 acre-feet, which is 13,000 acre-feet less than during the preceding 5-year period, 1985-89.

Water levels declined from March 1990 to March 1995 in most of the Beryl-Enterprise area; however, water levels rose in the southern part of the area near Enterprise and in isolated areas in the north part of the area near Lund (fig. 32). The overall declines probably resulted from continued large withdrawals for irrigation. The largest declines, about 10 to 15 feet, were measured north and southeast of Beryl Junction. The largest rise, of almost 28 feet, was measured in a well 1 mile north of Enterprise. Rises in the north part of the area were all less than 1 foot.

The relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2 is shown in figure 33. The water level in well (C-35-17)36dcc-1 generally has declined about 74 feet from 1948 to 1994. The 1994 precipitation at Modena was 13.98 inches, which is 3.60 inches more than the average annual precipitation for 1936-94. The average annual precipitation during 1990-94 was 11.53 inches, which is 0.40 inch more than for 1985-89. The concentration of dissolved solids in water from well (C-34-16)28dcc-2 increased from about 460 milligrams per liter in 1967 to about 680 milligrams per liter in 1994.

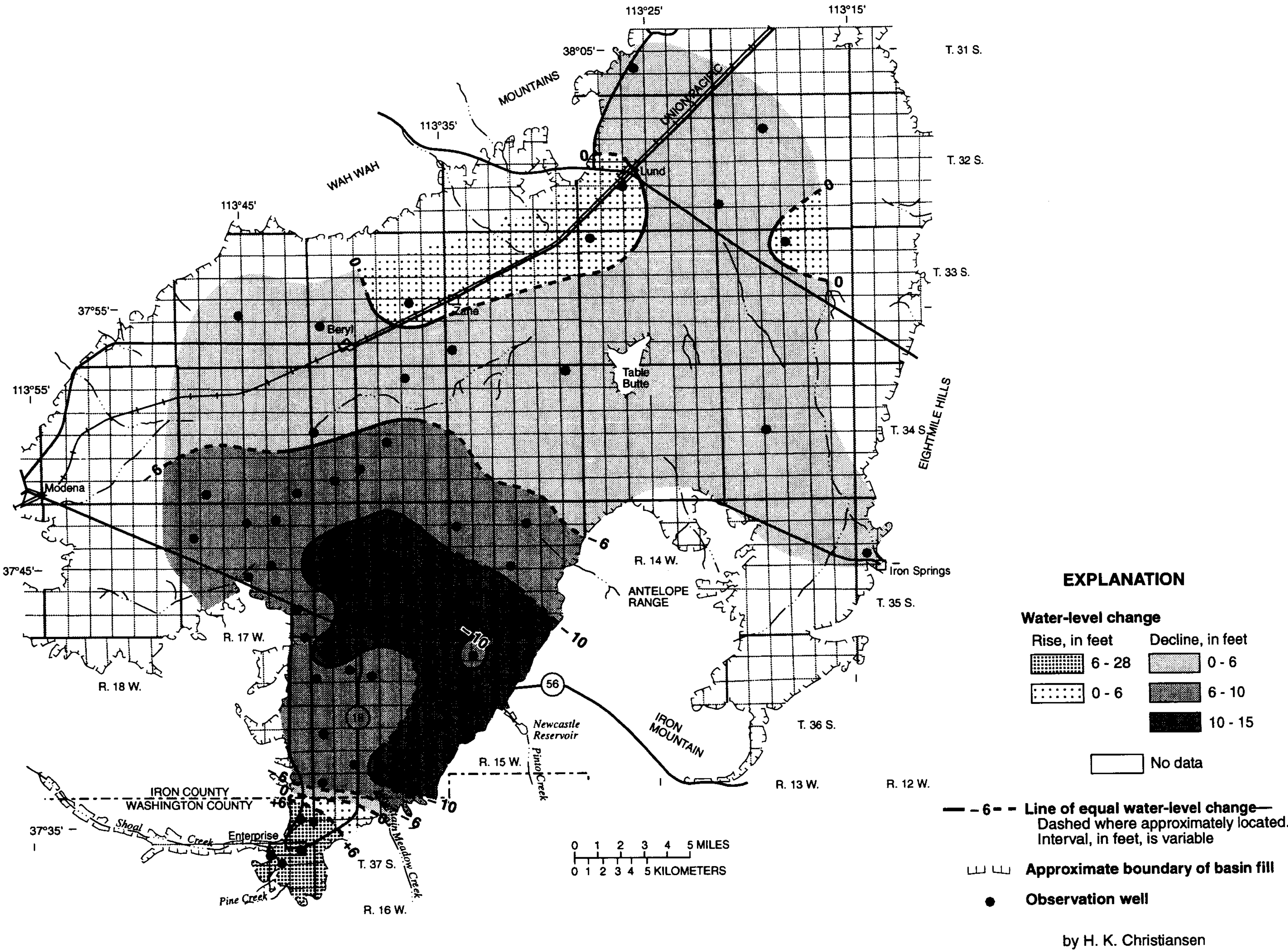



**Figure 32.** Map of the Beryl-Enterprise area showing change of water levels from March 1990 to March 1995.

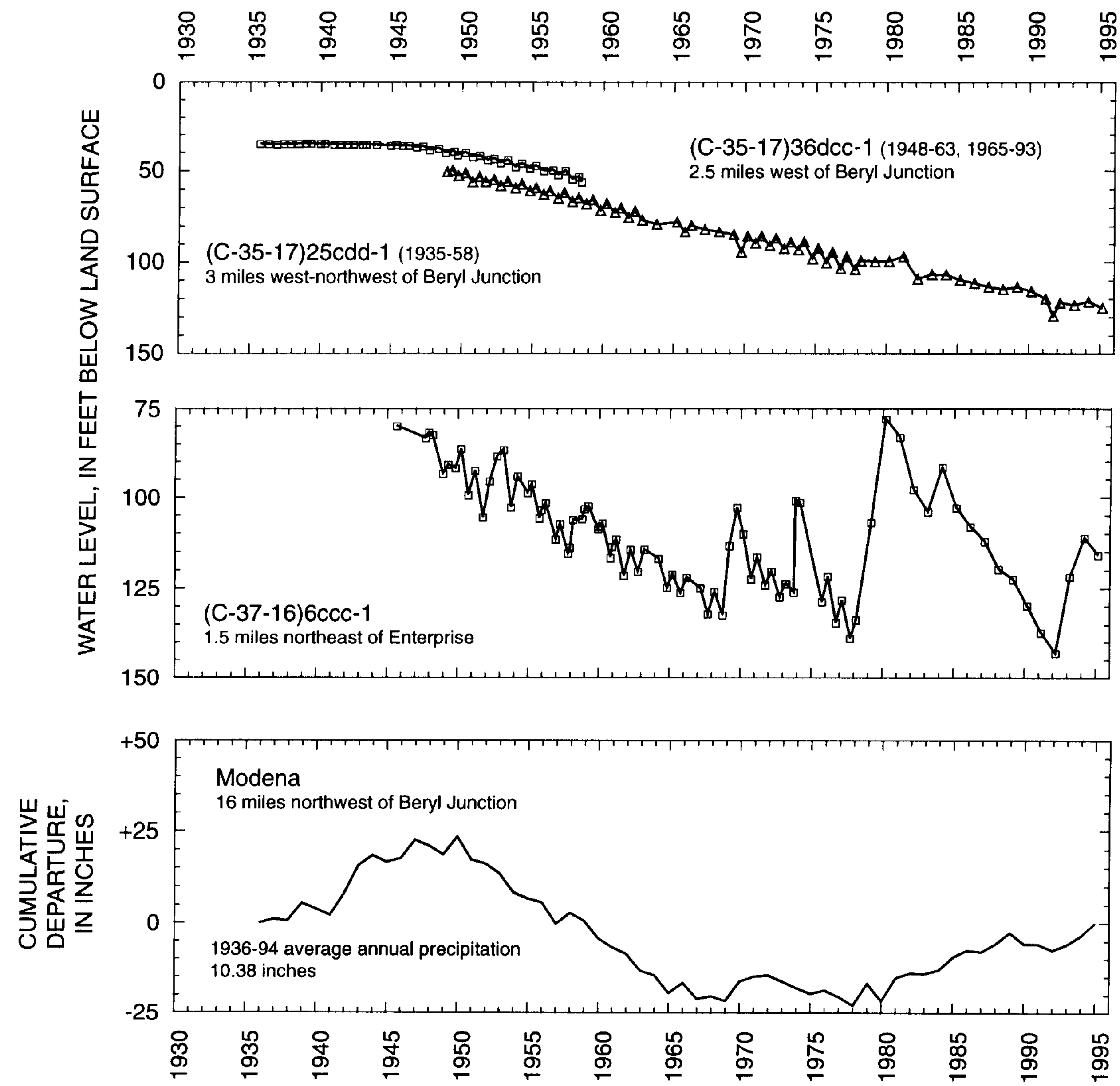



**Figure 33.** Relation of water levels in selected wells in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2.

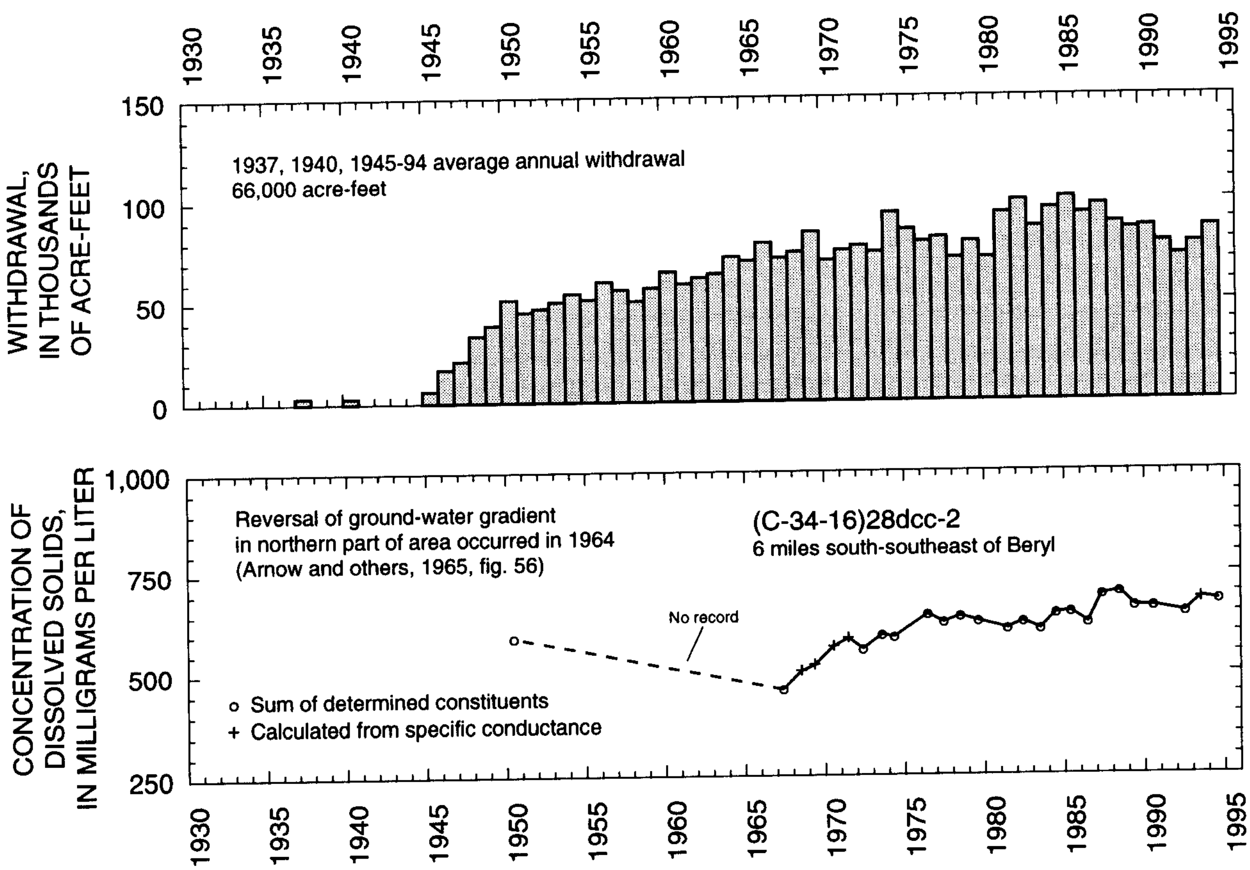



**Figure 33.** Relation of water levels in selected wells in the Beryl-enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-34-16)28dcc-2—Continued.

## CENTRAL VIRGIN RIVER AREA

By H.K. Christiansen

Withdrawal of water from wells in the central Virgin River area in 1994 was about 14,000 acre-feet, which is 1,000 acre-feet more than was reported for 1993 and 4,000 acre-feet less than the average annual withdrawal for 1984-93 (tables 2 and 3). This withdrawal includes water from valley-fill aquifers used primarily for irrigation and water from consolidated rock and valley fill, most of which is used for public supply. Withdrawals for irrigation in 1994 were about 700 acre-feet more than in 1993, and withdrawals for industry in 1994 were about 150 acre-feet less than in 1993. Withdrawals for public supply were about 100 acre-feet less than the 1993 estimate. The average annual withdrawal for 1990-94 was 16,000 acre-feet, which is about 4,000 acre-feet less than during the preceding 5-year period, 1985-89.

Water levels rose in the western part of the central Virgin River area from February 1990 to February 1995 (fig. 34). The greatest rise, of about 8.2 feet, occurred in the Santa Clara area. The rises probably resulted from local decreases in withdrawal for irrigation and greater-than-average precipitation in the Santa Clara River drainage in 1994. Water levels declined in areas east and southeast of St. George and west of Hurricane, with the largest decline, about 7.5 feet, in the area east of Harrisburg Junction.

The relation of water levels in selected wells to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1, is shown in figure 35. The water level in well (C-43-15)25ddd-1 has declined about 74 feet since 1961, probably as a result of local withdrawal. Discharge of the Virgin River at Virgin in 1994 was about 94,400 acre-feet, which is 172,300 acre-feet less than the revised value of 266,700 acre-feet for 1993, and about 40,500 acre-feet less than the long-term average. The 1990-94 average annual discharge of about 122,800 acre-feet is 8,400 acre-feet more than during the preceding 5-year period, 1985-89. Precipitation at St. George in 1994 was 8.91 inches, which is 0.99 inch more than the average annual precipitation for 1947-94. The average annual precipitation during 1990-94 was 8.20 inches, which is 0.13 inch more than during the preceding 5-year period, 1985-89. The graph of concentration of dissolved solids in water from well (C-41-17)17cba-1 indicates little overall change since 1966.

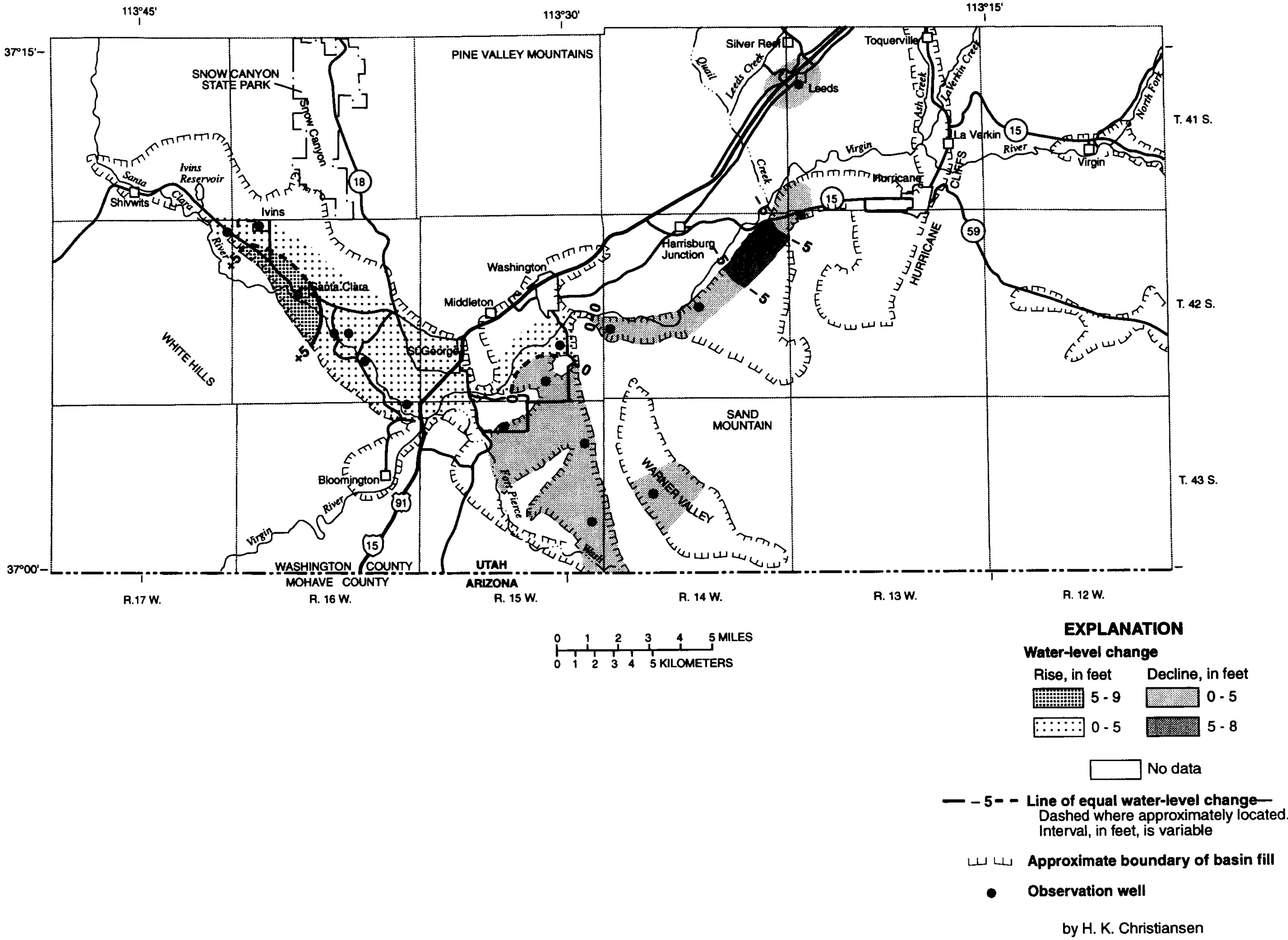



**Figure 34.** Map of the central Virgin River area showing change of water levels from February 1990 to February 1995.

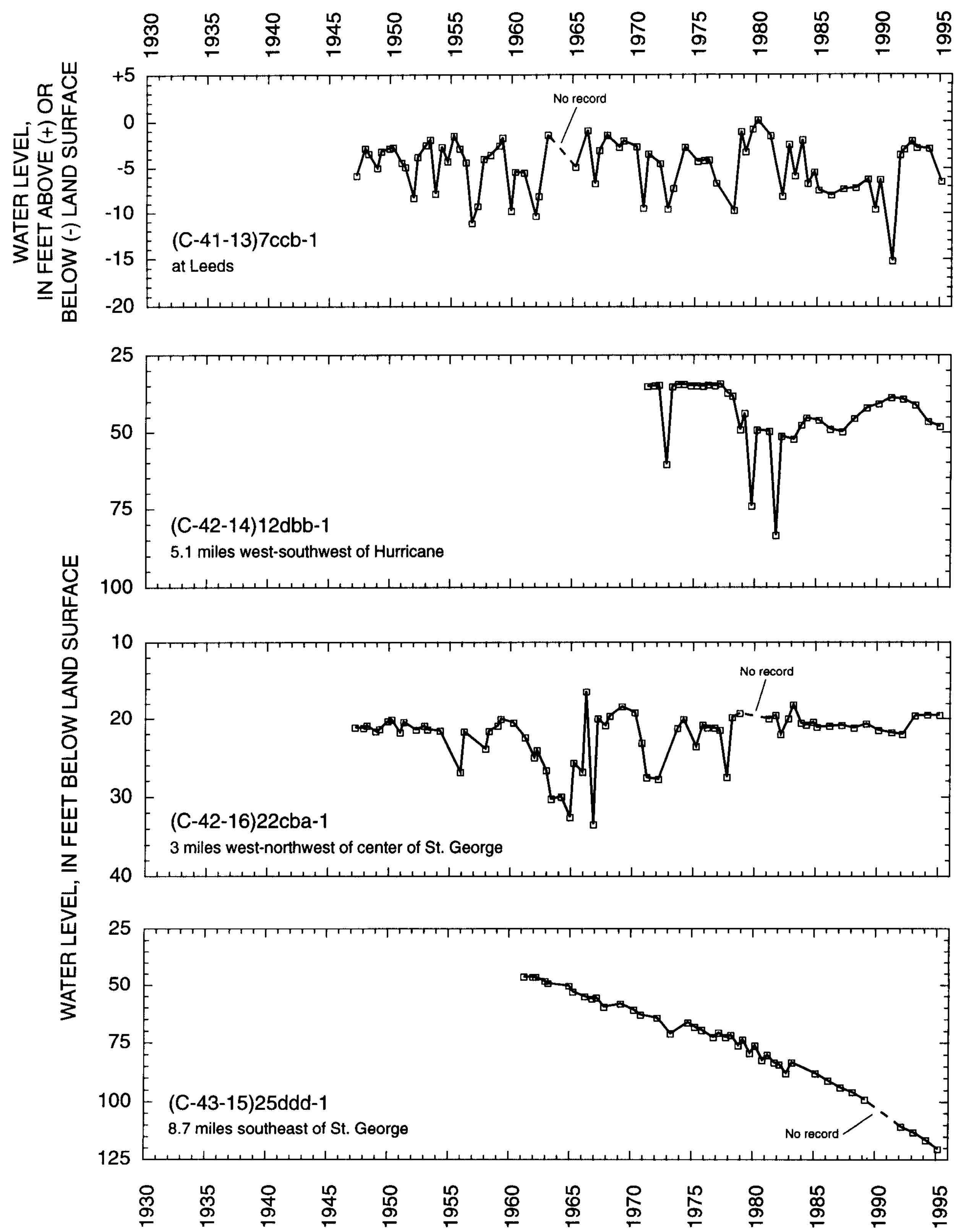



**Figure 35.** Relation of water levels in selected wells in central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1.

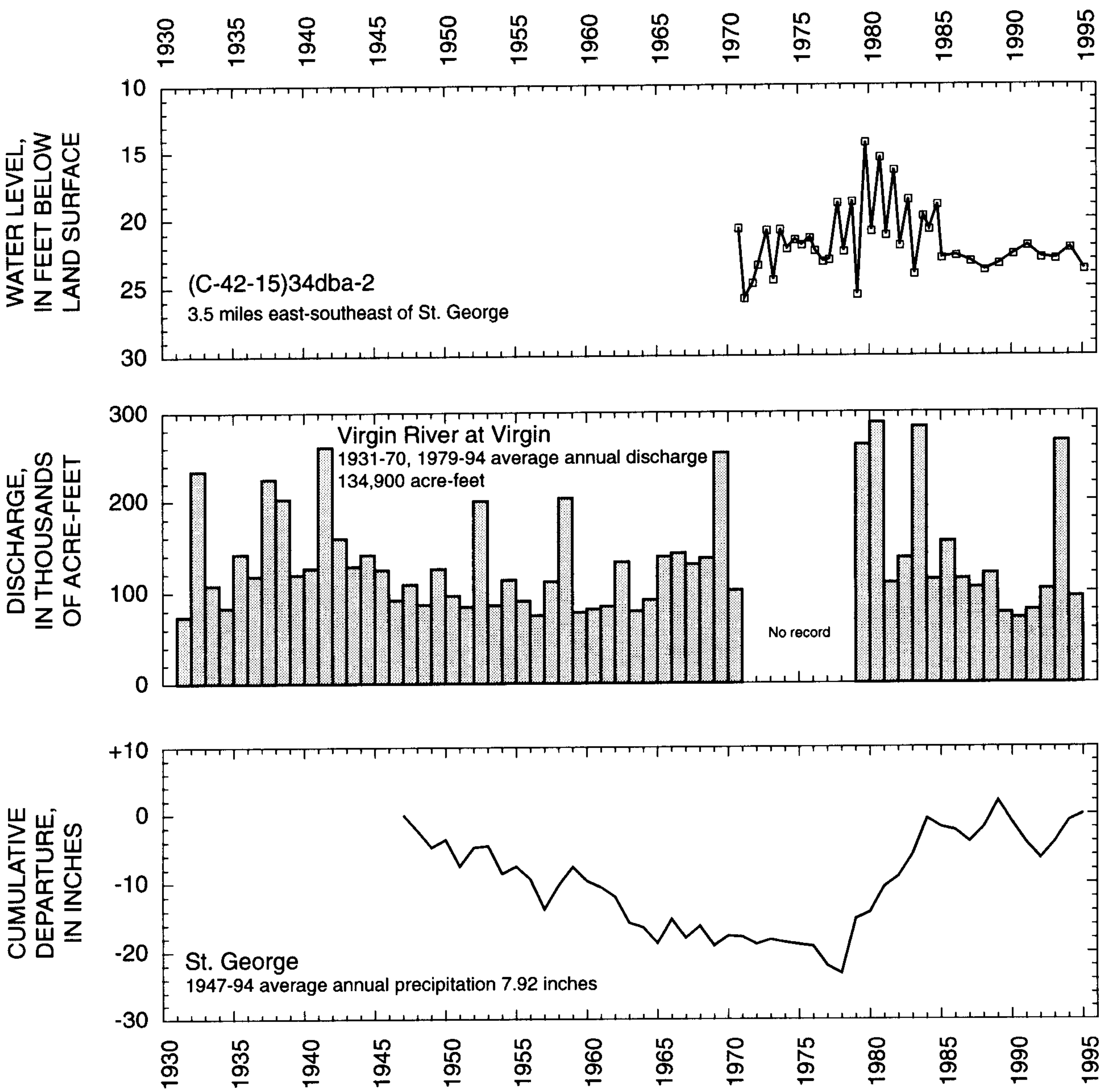



**Figure 35.** Relation of water levels in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

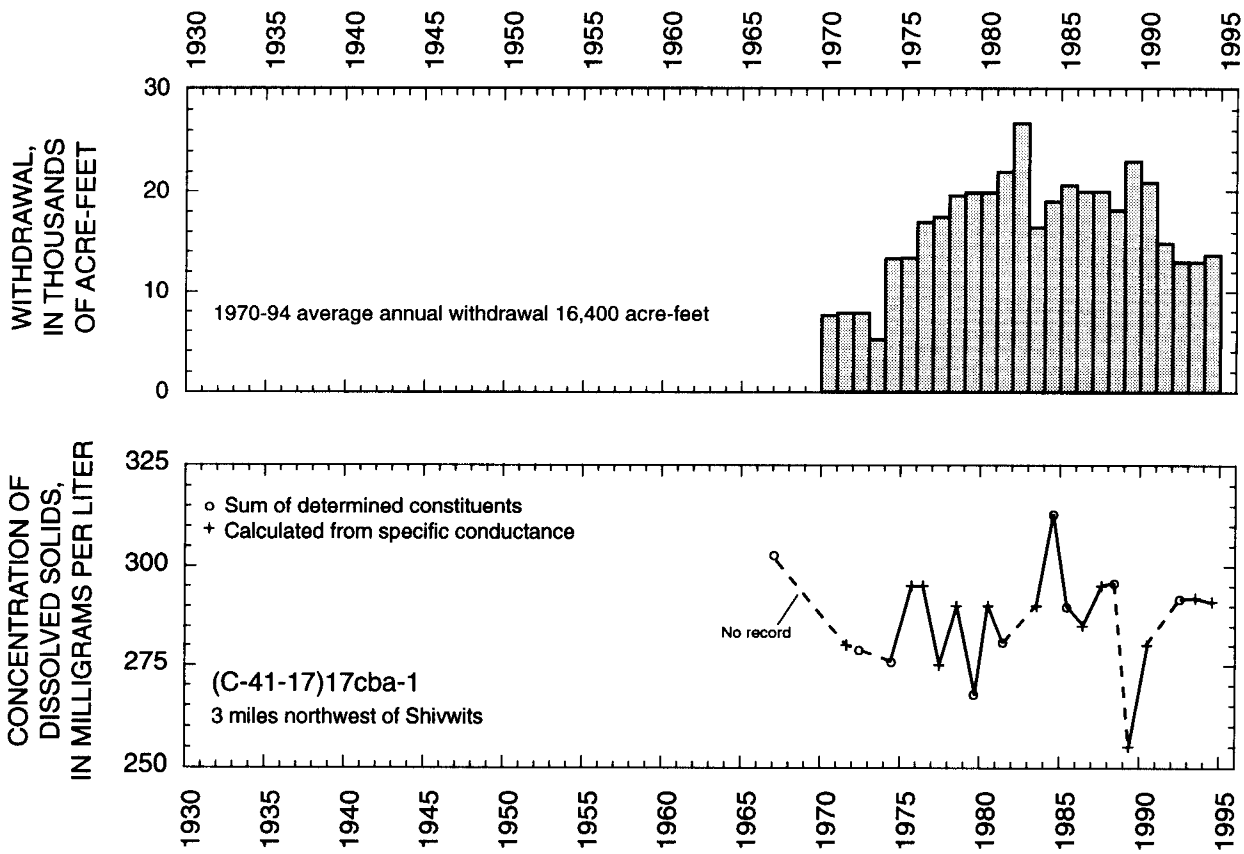



**Figure 35.** Relation of water levels in selected wells in the central Virgin River area to annual discharge of the Virgin River at Virgin, to cumulative departure from the average annual precipitation at St. George, to annual withdrawals from wells, and to concentration of dissolved solids in water from well (C-41-17)17cba-1—Continued.

## OTHER AREAS

### By A.D. Bagley

Withdrawal of water from wells in the areas of Utah listed below in 1994 was about 113,000 acre-feet.

| Number in figure 1 | Area | Estimated withdrawal (acre-feet) 1993 | 1994 |
|---|---|---|---|
| 1 | Grouse Creek Valley | 2,900 | 3,900 |
| 2 | Park Valley | 2,400 | 2,600 |
| 4 | Malad-lower Bear River Valley[1] | 7,100 | 11,800 |
| 8 | Ogden Valley | 11,700 | 13,100 |
| 13 | Dugway Area, Skull Valley, and Old River Bed | 3,700 | 6,100 |
| 14 | Cedar Valley, Utah County | 3,000 | 2,900 |
| 19 | Sanpete Valley | 8,800 | 11,500 |
| 24 | Snake Valley | 11,500 | 13,500 |
| 26 | Beaver Valley | 7,100 | 7,700 |
| | Remainder of State | [2]36,300 | 40,200 |
| Total (rounded) | | [2]94,000 | 113,000 |

[1]Tabulated as part of "Remainder of State" in previous reports.
[2]Previously unpublished revision.

The total withdrawal of water from wells in 1994 was 19,000 acre-feet more than was reported for 1993 and 20,000 acre-feet more than the average annual withdrawal for 1984-93 (tables 2 and 3). In the areas listed, withdrawals in 1994 were more than in 1993, except in Cedar Valley (Utah County). The increase in total withdrawal resulted from increased withdrawals for irrigation and public supply.

Water-level changes in Cedar Valley (Utah County) are shown in figure 37. Water levels declined from March 1990 to March 1995 in the north and west parts of Cedar Valley because of larger-than-average withdrawals of water from wells during 1990-94 as compared with the preceding 5-year period, 1985-89. The average annual withdrawal during 1990-94 was about 3,100 acre-feet, which is 1,200 acre-feet more than during 1985-89. Rises in water levels along the east side of the valley probably resulted from greater-than-average precipitation and increased local recharge. The average annual precipitation at Fairfield in 1994 was 12.43 inches, which is 0.77 inch more than during 1943-94 (fig. 38). The average annual precipitation during 1990-94 was 12.25 inches, which is 0.59 inch more than the long-term annual average and 0.59 inch more than the preceding 5-year annual average.

Water levels from March 1990 to March 1995 generally declined in the northern and extreme southern parts of Sanpete Valley, with small localized areas of water-level rises in the north and northeast parts of the valley (fig. 37). Water levels generally rose in the southern half of Sanpete Valley. The decline in water levels in the Sanpete Valley probably resulted from less-than-average precipitation and increased withdrawals from wells.

The annual precipitation at Manti for 1994 was 12.20 inches, which is 0.95 inch less than the 1935-94 average annual precipitation (fig. 38) and 0.76 inch less than the 1990-94 average annual precipitation. The average annual precipitation at Manti during 1990-94 was 12.96 inches, which is 0.28 inch less than during the preceding 5-year period, 1985-89. In 1994, the withdrawal of ground water from wells in Sanpete Valley was about 11,500 acre-feet, which is 2,700 acre-feet more than in 1993. The average annual withdrawal during 1990-94 was about 13,100 acre-feet, which is 2,300 acre-feet more than during 1985-89.

The relation of water levels in 21 observation wells in selected areas of Utah to cumulative departure from the average annual precipitation at 18 sites in or near those areas is shown in figure 38. Water levels from March 1990 to March 1995 declined in 11 and rose in 9 of the 20 observation wells. From 1994 to 1995, water levels declined in 12 and rose in 8 of the 20 observation wells. The declines were a result of greater-than-average withdrawals of water from wells during 1990-94, as compared with the preceding 5-year period, 1985-89 (table 3). Average annual precipitation during 1990-94 was less than during the 1985-89 period at 8 of the 18 precipitation sites.

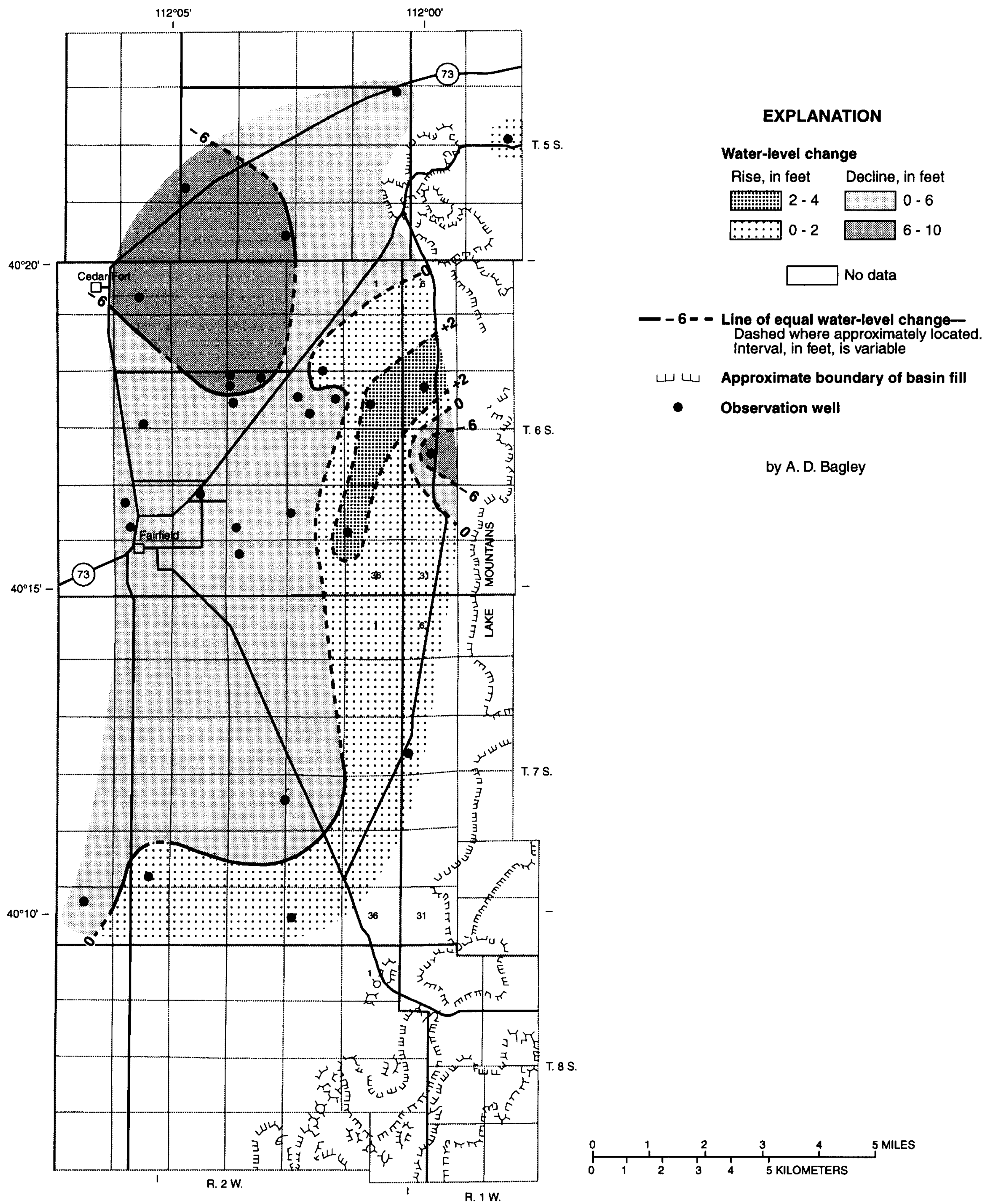



**Figure 36.** Map of Cedar Valley, Utah County, showing change of water levels from March 1990 to March 1995.

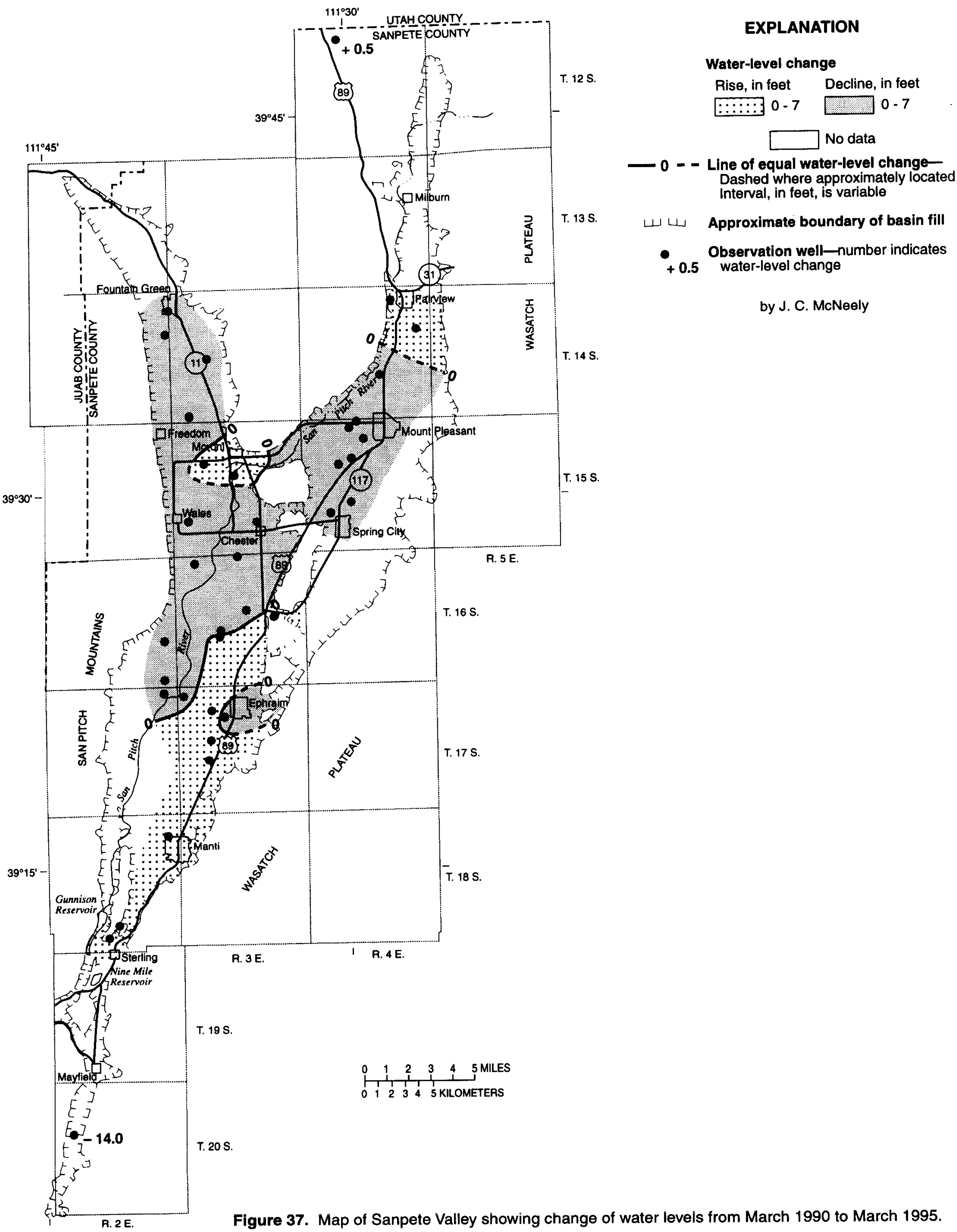



**Figure 37.** Map of Sanpete Valley showing change of water levels from March 1990 to March 1995.

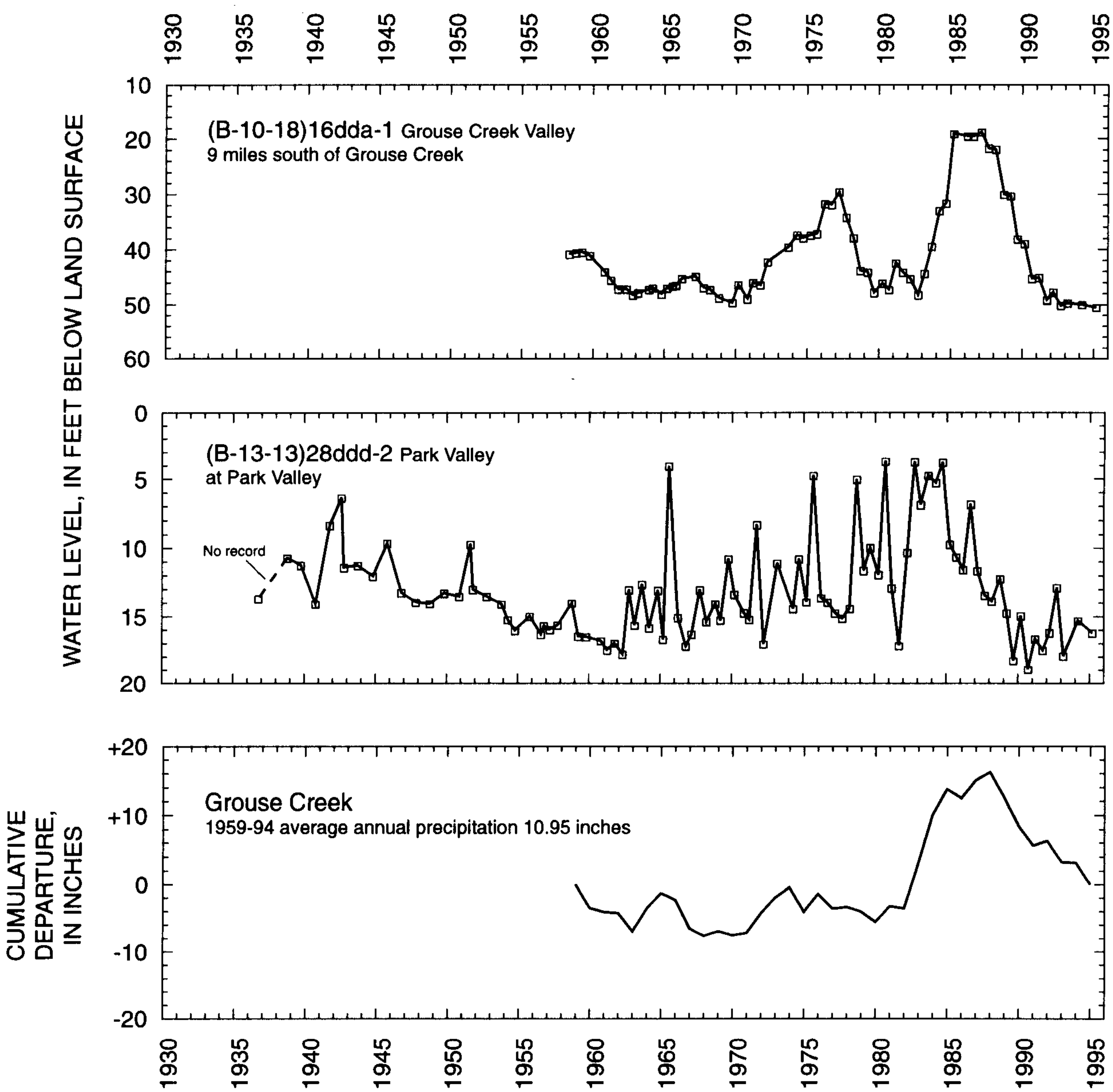



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

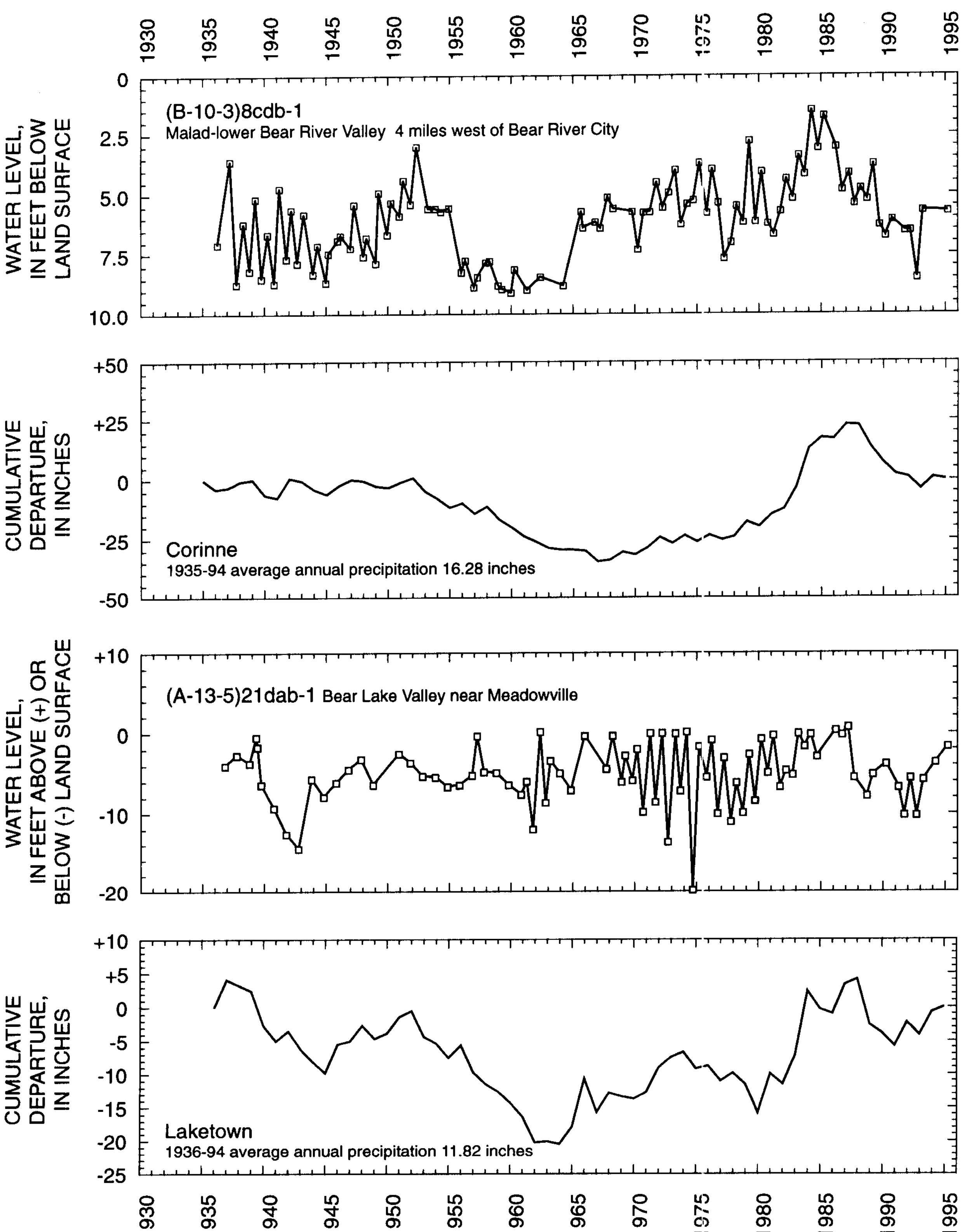



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

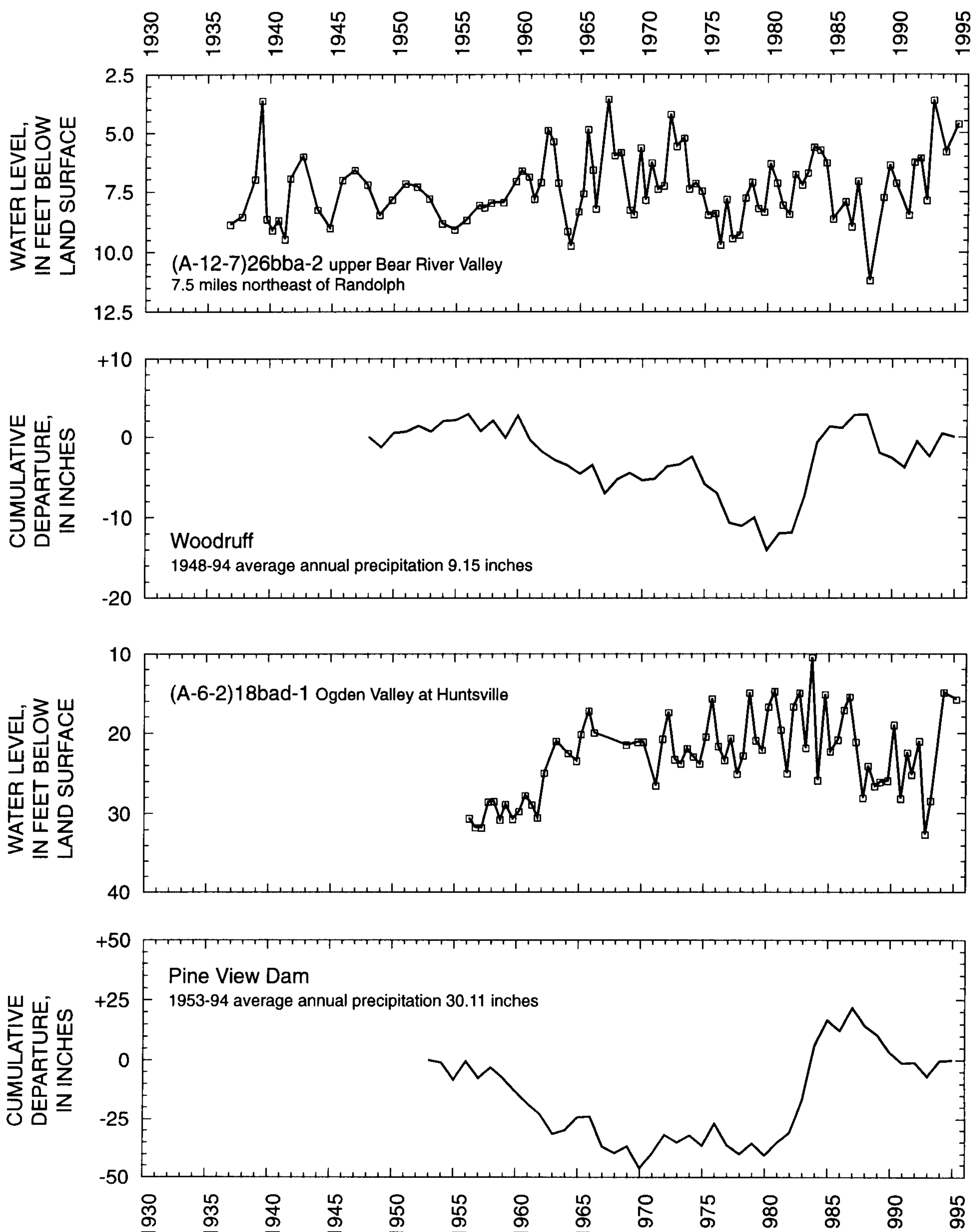



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

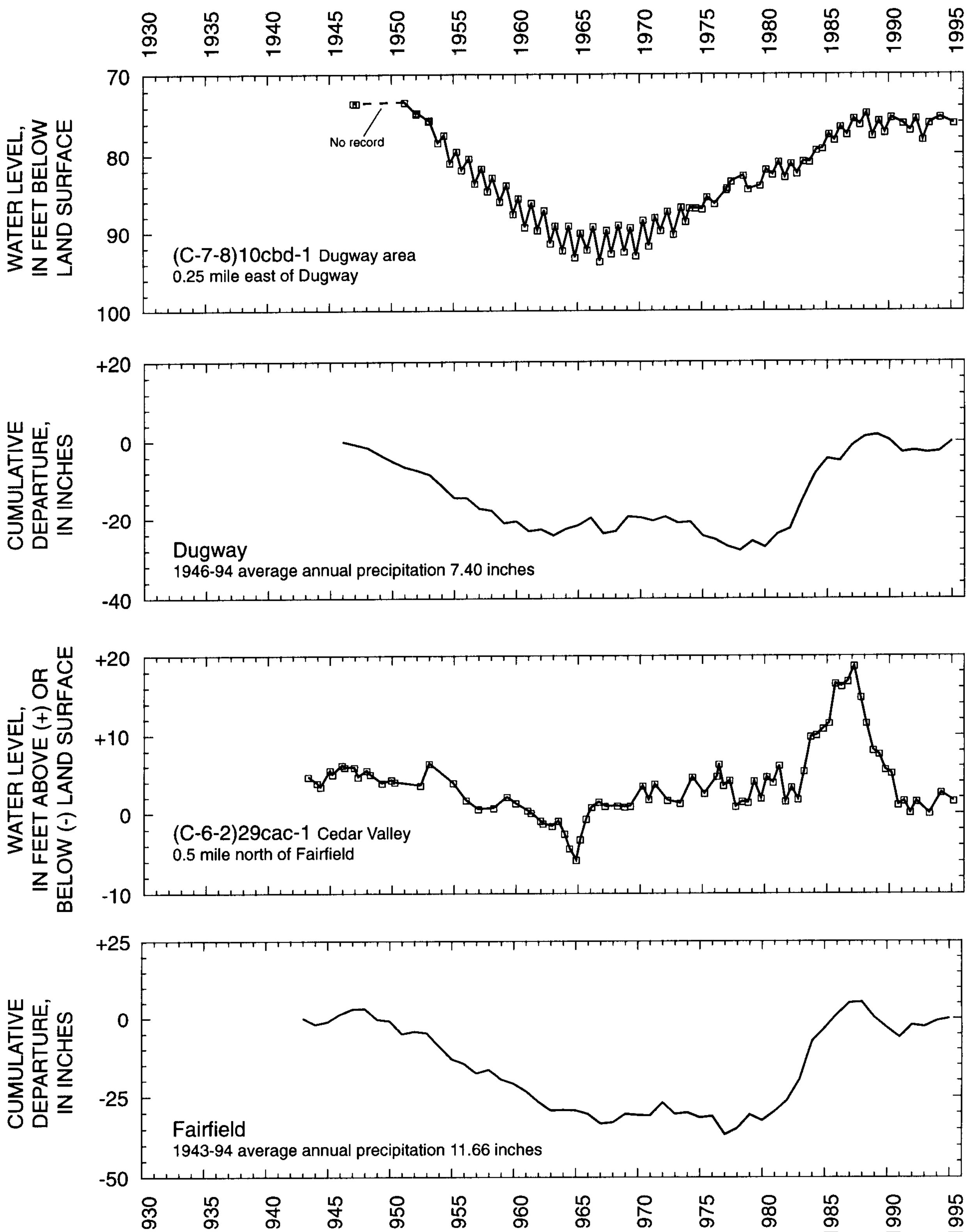



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

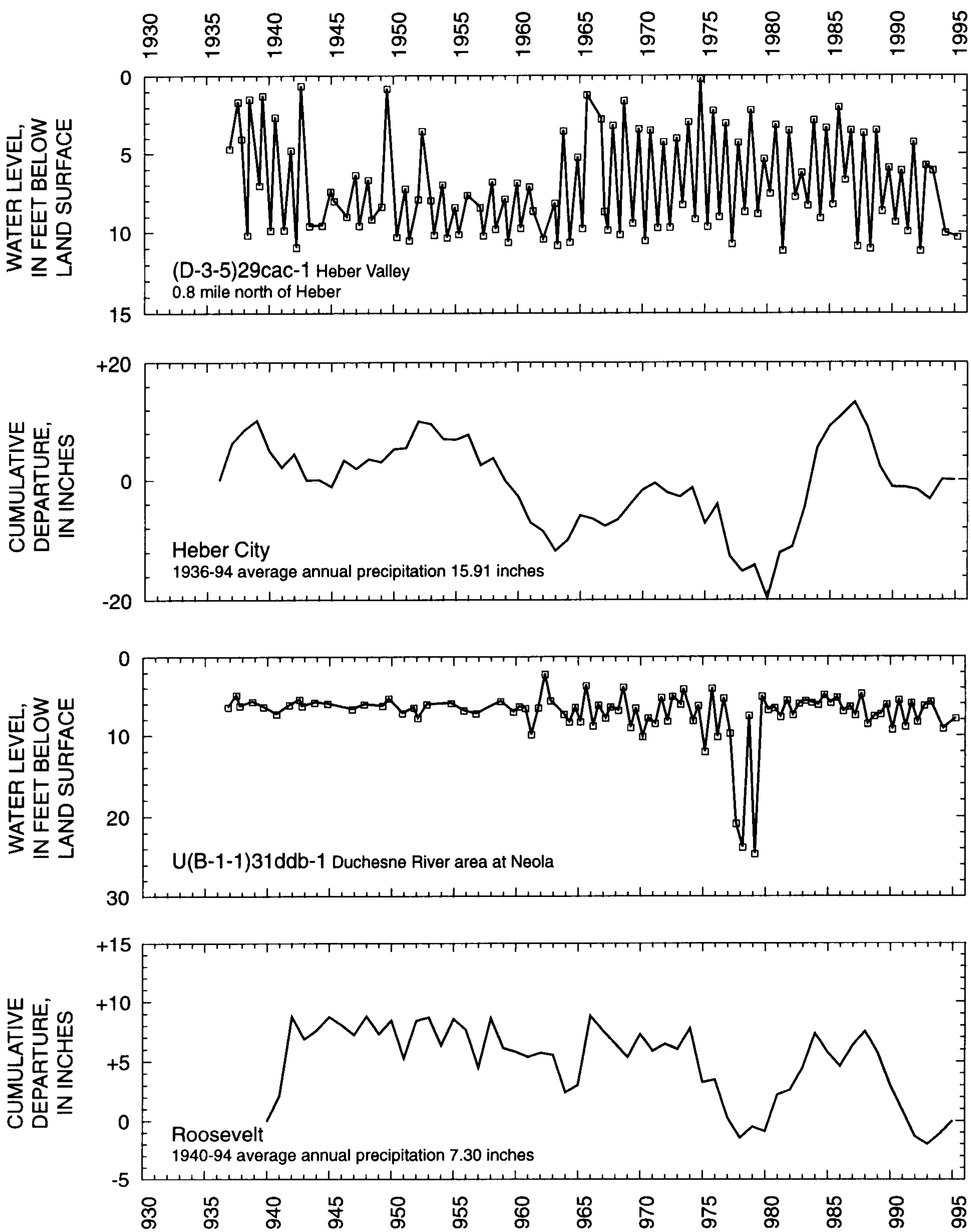



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

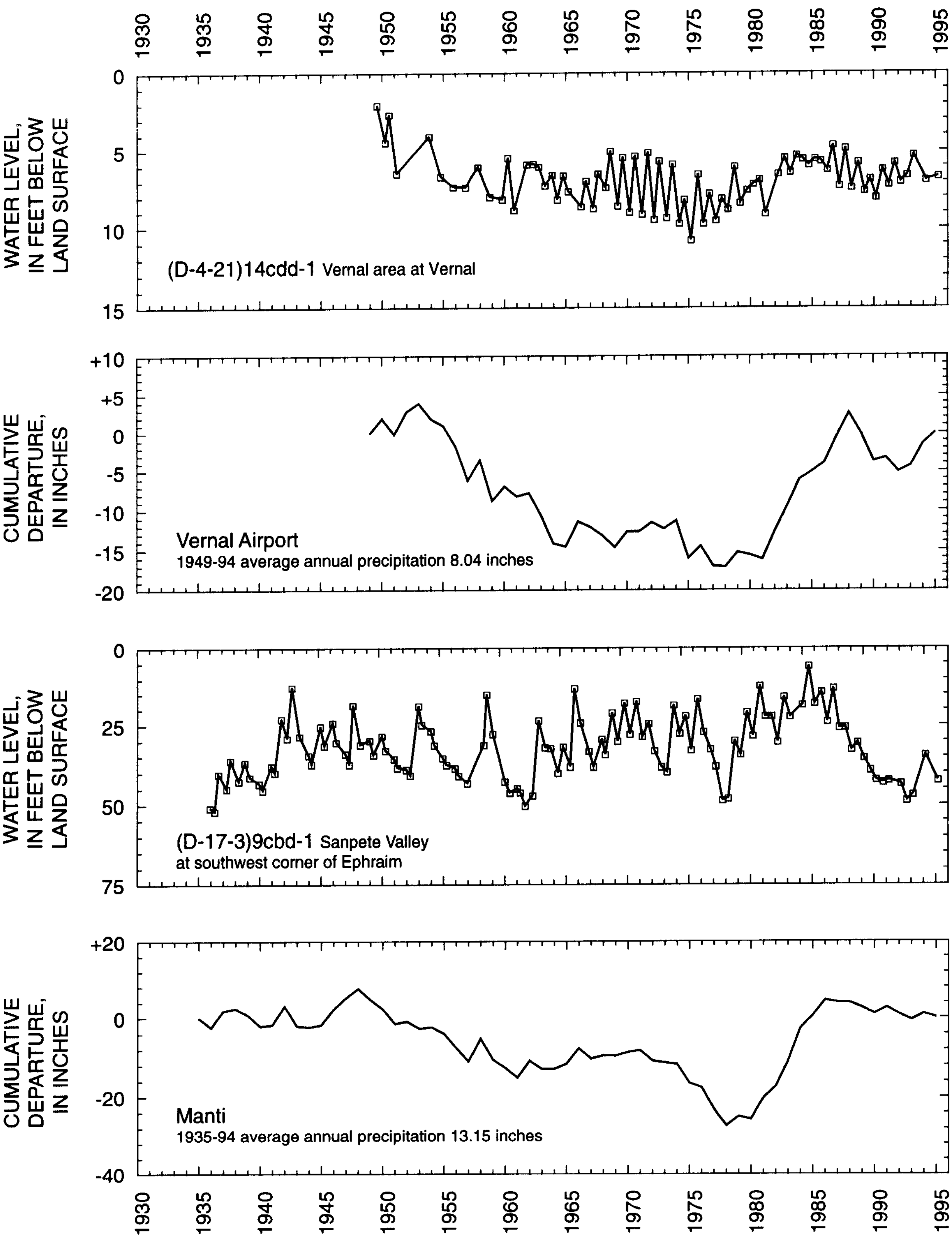



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

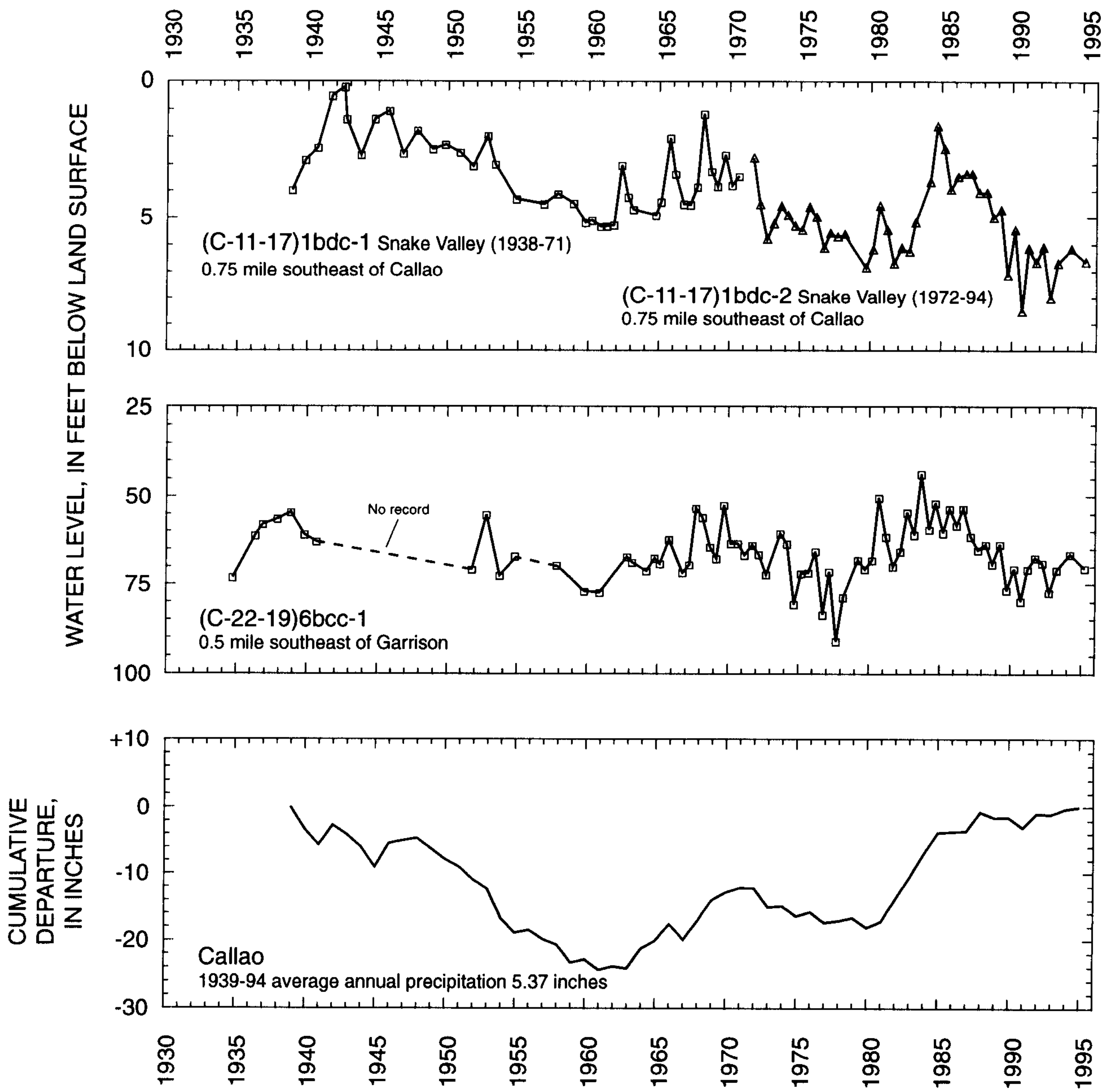



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

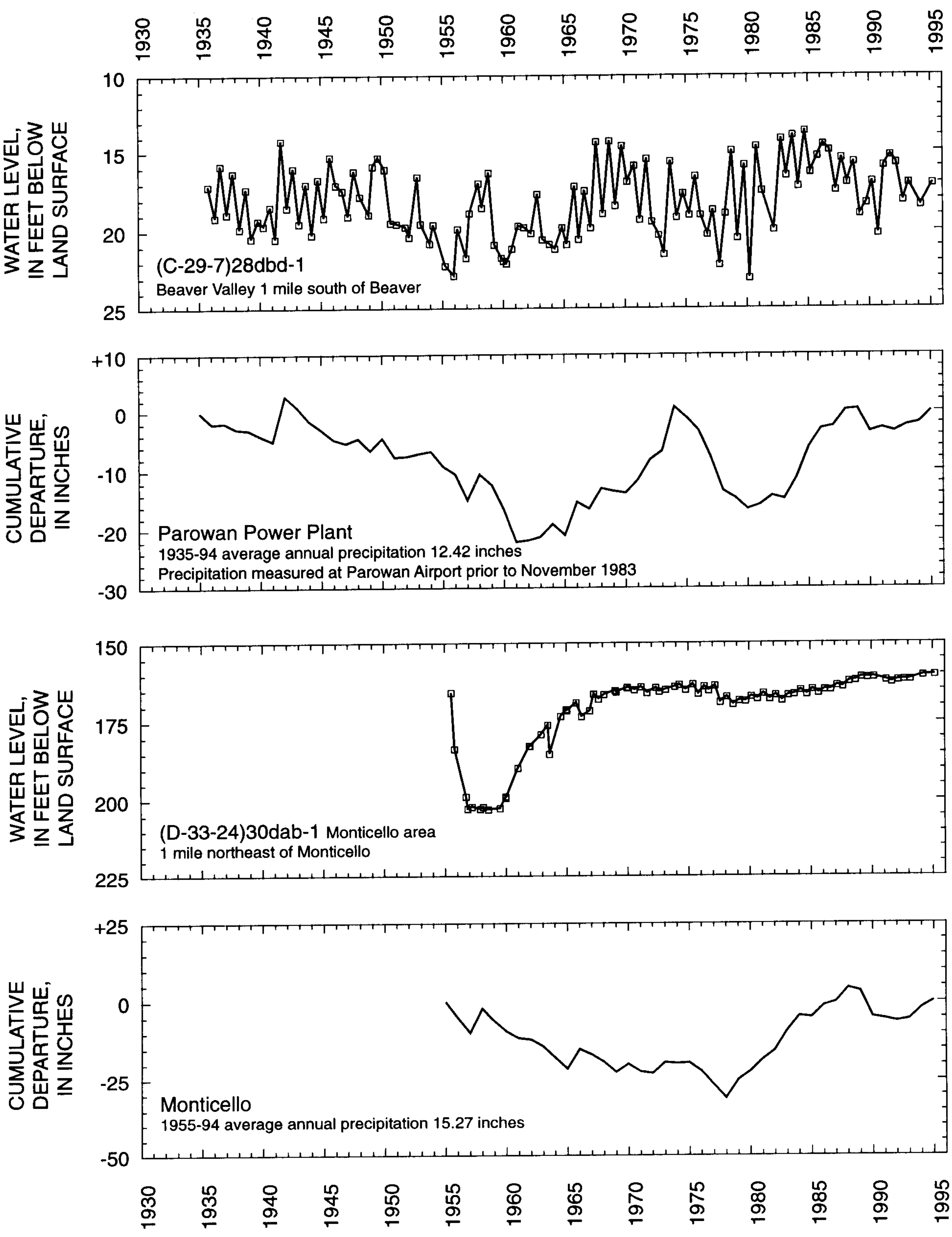



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

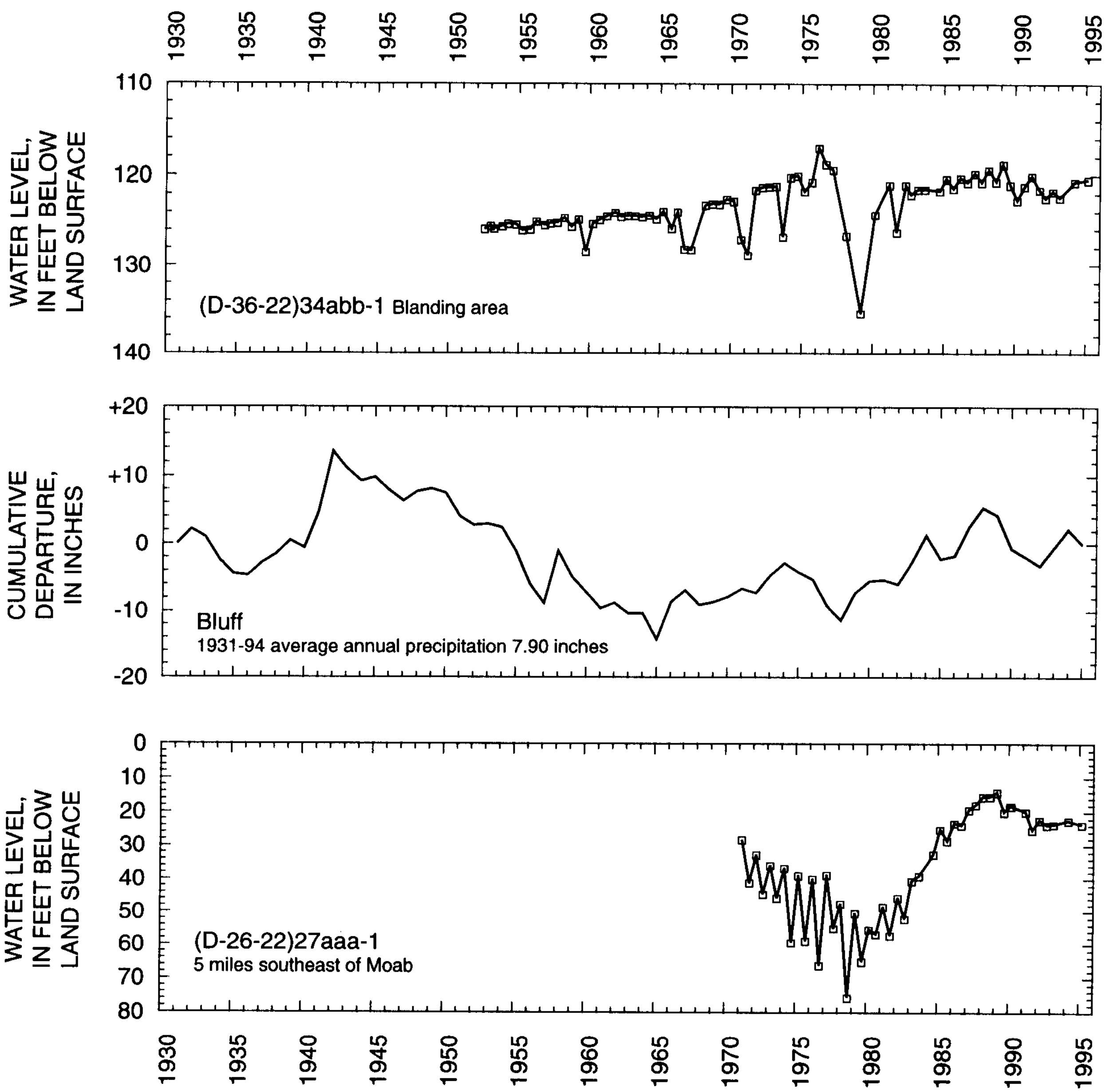



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

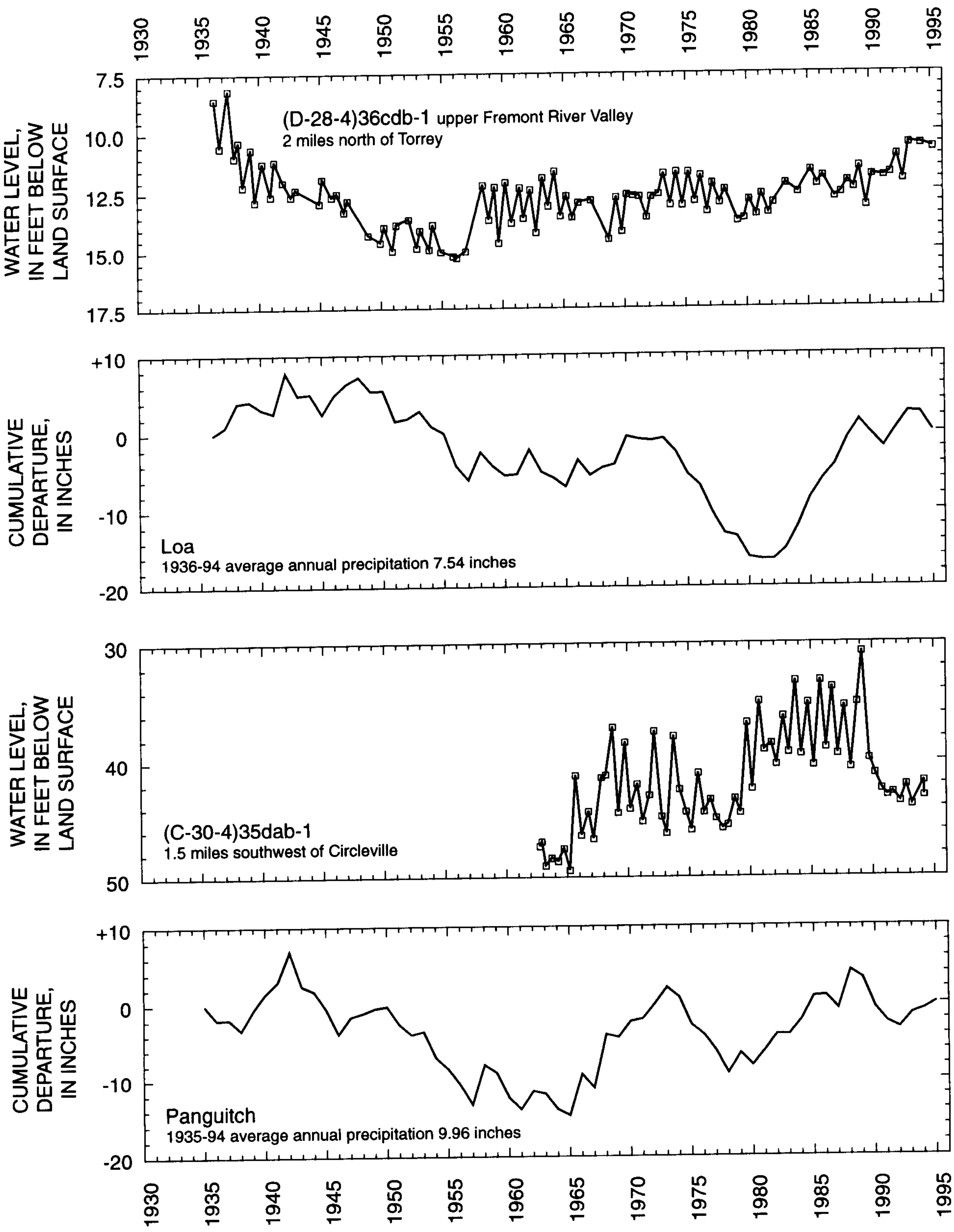



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

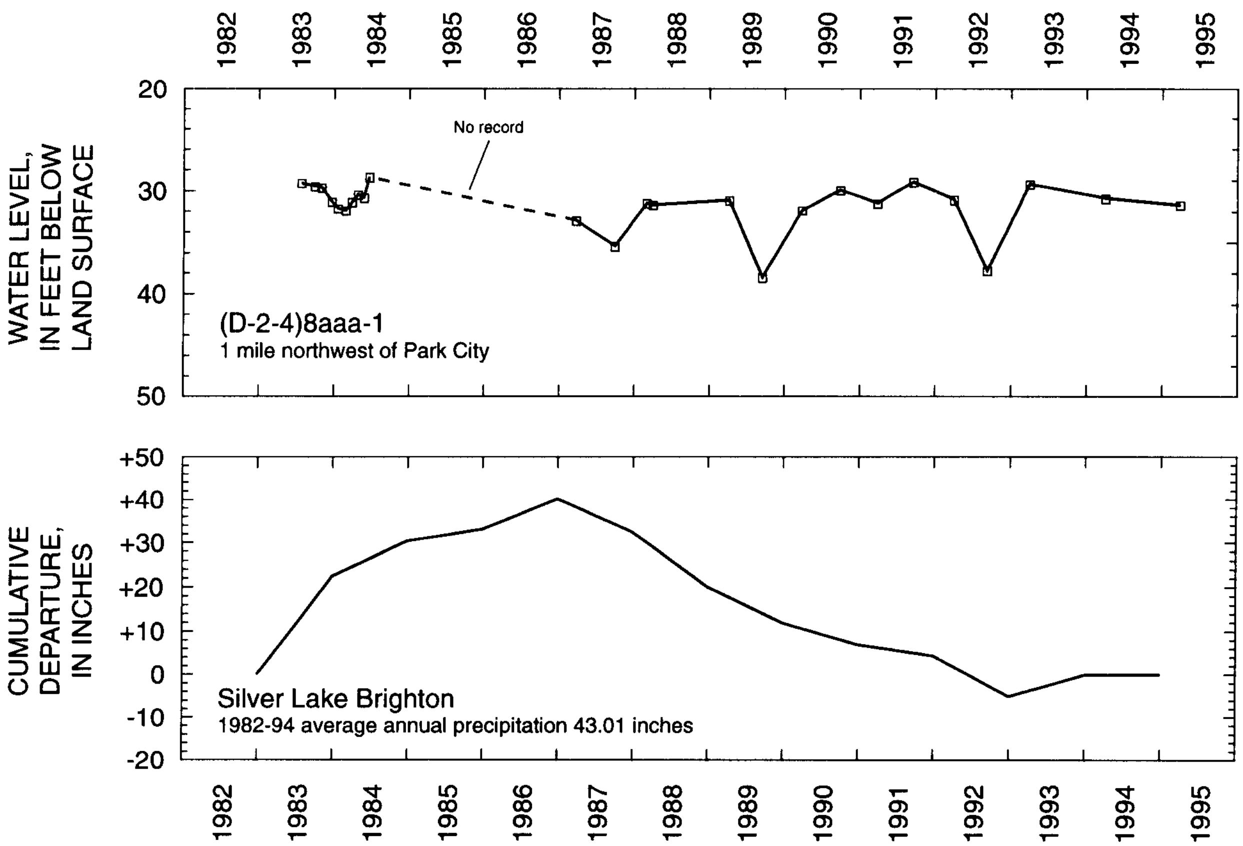



**Figure 38.** Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas—Continued.

# REFERENCES


Allen, D.V., Garrett, R.B., and others, 1994, Ground-water conditions in Utah, spring of 1994: Utah Division of Water Resources Cooperative Investigations Report No. 34, 89 p.

Arnow, Ted, and others, 1965, Ground-water conditions in Utah, spring of 1965: Utah Division of Water Resources Cooperative Investigations Report No. 3, 99 p.

Handy, A.H., Mower, R.W., and Sandberg, G.W., 1969, Changes in chemical quality of ground water in three areas in the Great Basin, Utah, *in* Geological Survey Research, 1969: U.S. Geological Survey Professional Paper 650-D, p. D228-D234.

National Oceanic and Atmospheric Administration, 1993-94, Climatological data, Utah: Ashville, N.C., National Climatic Data Center, v. 95, no. 1-12, [variously paged].

450 11/95

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